WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electrical Code (ANSI C1) and/or any other requirements which may be applicable to the user.

Installation, operation, and maintenance should be performed only by qualified personnel.

(REV. A)

TM-110235

VOLUME I

OPERATOR'S MANUAL

626-PA-6003

3-PHASE AC MONITOR

1 October 1981

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DRANETZ

DRANETZ ENGINEERING LABORATORIES, INCORPORATED
1000 New Durham Road, CN-91, Edison, N.J. 08818

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626-PA-6003 3-PHASE AC MONITOR

1 INTRODUCTION

This manual provides instructions for the 626-PA-6003 Plug-in, hereinafter referred to as the 6003, used in the Model 626 Universal Disturbance Analyzer. It is assumed that the reader is familiar with the mainframe information described in TM-106650.

2 PURPOSE

The 6003 monitors disturbances on 3-phase AC power lines. Each phase is monitored on a single voltage range of 0 to 600V RMS. With thresholds programmed by the user, the 6003 monitors both short and long term power line disturbances. With this plug-in, the unit stores, analyzes, classifies and prints out quantative and qualitative disturbance data. Accompanying the data is a printout of time derived from a highly accurate crystal-controlled 24-hour clock in the mainframe.

The plug-in monitors any 3-phase power line whose RMS values range from a low value of 0 volts to as high as 600 volts. Three types of disturbances are monitored by the 6003: power line frequency, power frequency transients and waveform disturbances. Power frequency transients are divided into five display categories: overvoltage, undervoltage, voltage change, voltage surge and voltage sag. Waveform disturbances, identified as "impulses," include all conditions that cause the power line waveform to deviate from an ideal waveform. The 6003 measures the peak amplitude of impulses, their polarity and duration. The threshold value of each type of disturbance, as well as the line frequency, above which detection and printout occurs is operator programmable. (All threshold settings are common to all three line phases.) Except for an automatic summary printout at the end of each day, disturbance data is normally printed out only when disturbances occur. In an alternate mode, a disturbance data summary printout occurs only at the end of each day. This feature permits long term unattended operation.

The threshold program may be easily altered, using the front panel switches. Cueing indicators adjacent to the programming switches simplify the programming procedure. A back-up program for the plug-in, stored in hard memory at the factory, may always be recalled upon operator demand. Both the program and the disturbance data in the data accumulators may be printed out upon demand.

NOTE: Frequency measurements are derived from phase A only. Therefore, if single-phase monitoring is desired, phase A should be used.

3 APPLICATIONS

When installed in the 626 mainframe, the 6003 provides the capability of monitoring and evaluating power system performance. Among its typical applications are the following:

a. To determine the effect of power systems operation on equipment malfunction. The time-referenced power fault disturbance record produced by the instrument permits rapid correlation of errors, outages, and equipment damage in computer, industrial process controls, digital communications equipment, medical monitoring apparatus, and so forth, to power line faults.

b. To perform pre-installation site surveys. The 6003 can be used to determine the adequacy of existing power lines intended to support critical electrical equipment. Anticipation of power problems saves time, money, and future trouble.

c. For diagnostic evaluation of power system performance. The portable instrument, particularly well suited for field use, is ideal for determining the probable causes of, and remedies for, power line disturbances.

d. For monitoring life test racks. The printout produced by the instrument provides a clear record of the quality of power supplied during unattended periods.

4 EQUIPMENT CHARACTERISTICS

The 6003 is configured as a plug-in module 6.5" high by 1.25" wide by 10" deep. It is designed for installation in one of four slots of the Model 626 Universal Disturbance Analyzer. Technical specifications of the 6003 are presented in Table 1.

Table 1. 626-PA-6003 Technical Specifications

Input	2 wire differential Z_{in} = 40 Megohms plus 40 pf (each side to ground)
Input Voltage Range	0-600V RMS
Lower Limit of User-Set Voltage (V_{LOW})	50V to 599V
Upper Limit of User-Set Voltage (V_{HIGH})	600V to 51V
Voltage Change Sensitivity (V_{SENS}) (1V Increments)	2 to 60V
Line Voltage Measurement Resolution	0.2V

Table 1. 626-PA-6003 Technical Specifications (Cont'd.)

Line Voltage Measurement Accuracy	±1% of reading, ±0.2% of full scale (75V to 600V)
Line Frequency	
Range	45 - 65 Hz
Resolution	±0.1 Hz
Accuracy	±0.1 Hz
Impulse Range	25 -4000V Pk (1-2000 uSec)
Impulse Peak Resolution	1 V
Impulse Accuracy	±10% of reading ±1%F.S. (5μSec-50μSec.) (decreasing to ±6db from 1μSec to 2mSec) 100V-4000V
Impulse Duration Range	1 uSec to 2 mSec
Impulse Duration Resolution	1 uSec

5 INSTALLATION

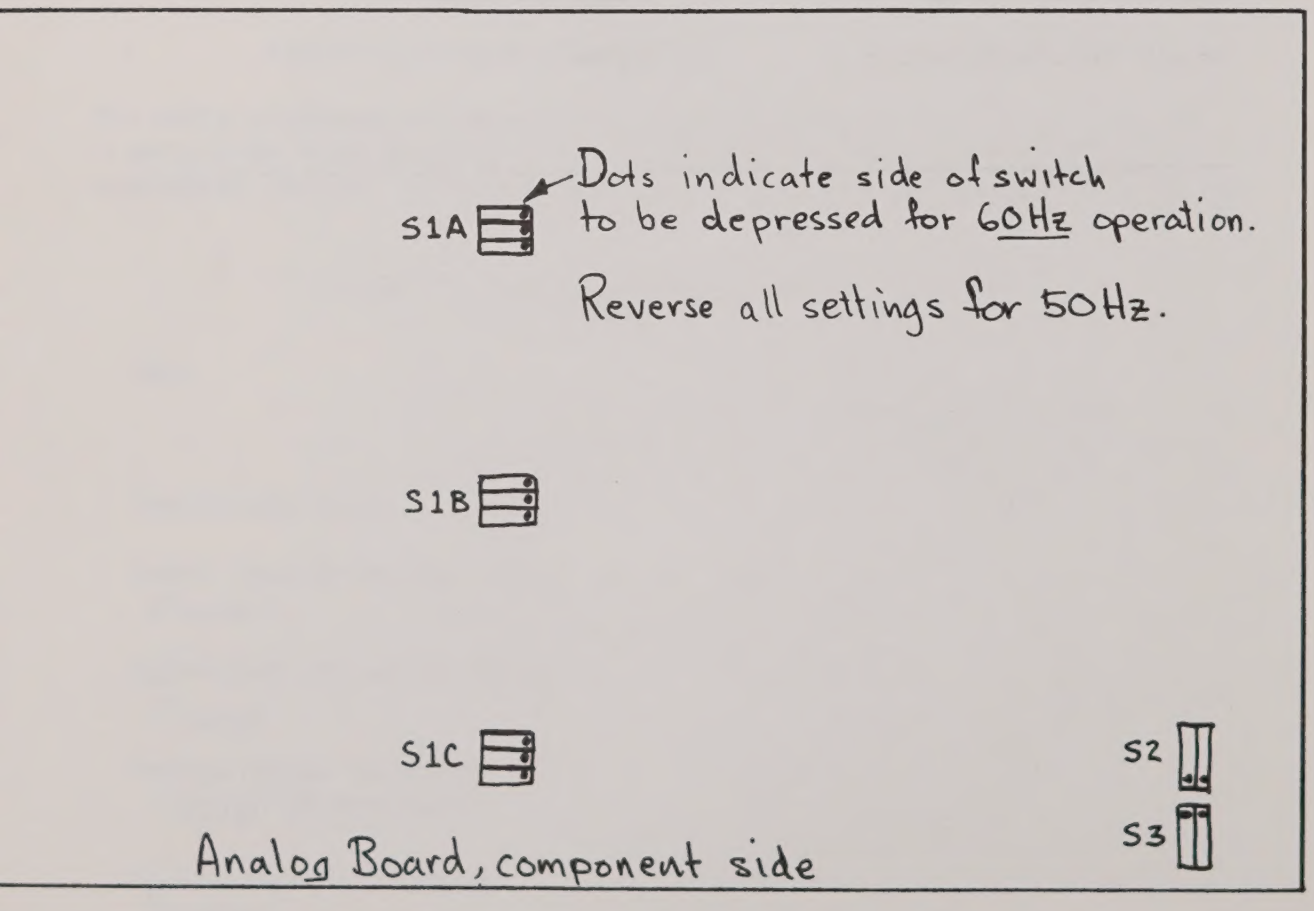
5.1 Selection of Nominal Operating Frequency

The 6003 has switches which are factory set so that measurements are optimized for a nominal frequency of either 50 or 60 Hz. Figure below shows the location of these switches on the Analog board of the module. Dots on switches on the figure indicate which side of the switch is to be depressed for 60Hz. For 50 Hz operation, simply reverse all switches.

5.2 Installation of 6003 in Mainframe

Do not attempt to install a 6003 module in slot 5 of the 626 mainframe. Slots 1-4 may be used, as follows:

a. With the rear panel markings reading correctly, carefully slide the module into the desired slot, with the Digital board within the card-guide tracks, until it is firmly seated.
b. Tighten the top and bottom captive screws to secure the module into the mainframe.



6 CONNECTING POWER SOURCE TO MODULE (See Figure 4)

The 6003 is equipped with three rear panel AC connectors, one each for phase A, B, and C. Mating connectors are supplied for the user. The 3-wire mating connectors must be wired in accordance with the rear panel connector markings (AC high, AC low, and earth ground from top to bottom).

a. Insert key in FUNCTION key switch on front panel of mainframe and set switch to OFF position.

b. Turn off AC power source that is to be used to power the module.

c. Attach the wired mating connector to the rear panel connector, then reapply AC power.

CAUTION

To avoid damaging the equipment, do not apply AC voltages in excess of 600V RMS to any AC phase (A, B, or C) applied to the 6003.

7 OPERATING THE 6003

7.1 Operating Controls and Indicators

The functions of the mainframe operating controls and indicators associated with 6003 operation are described in Table 2. Figure 1 shows the typical front panel controls on a Model 626 that are associated with a 6003 module. For a description of controls common to overall Model 626 operation, refer to TM-106650.

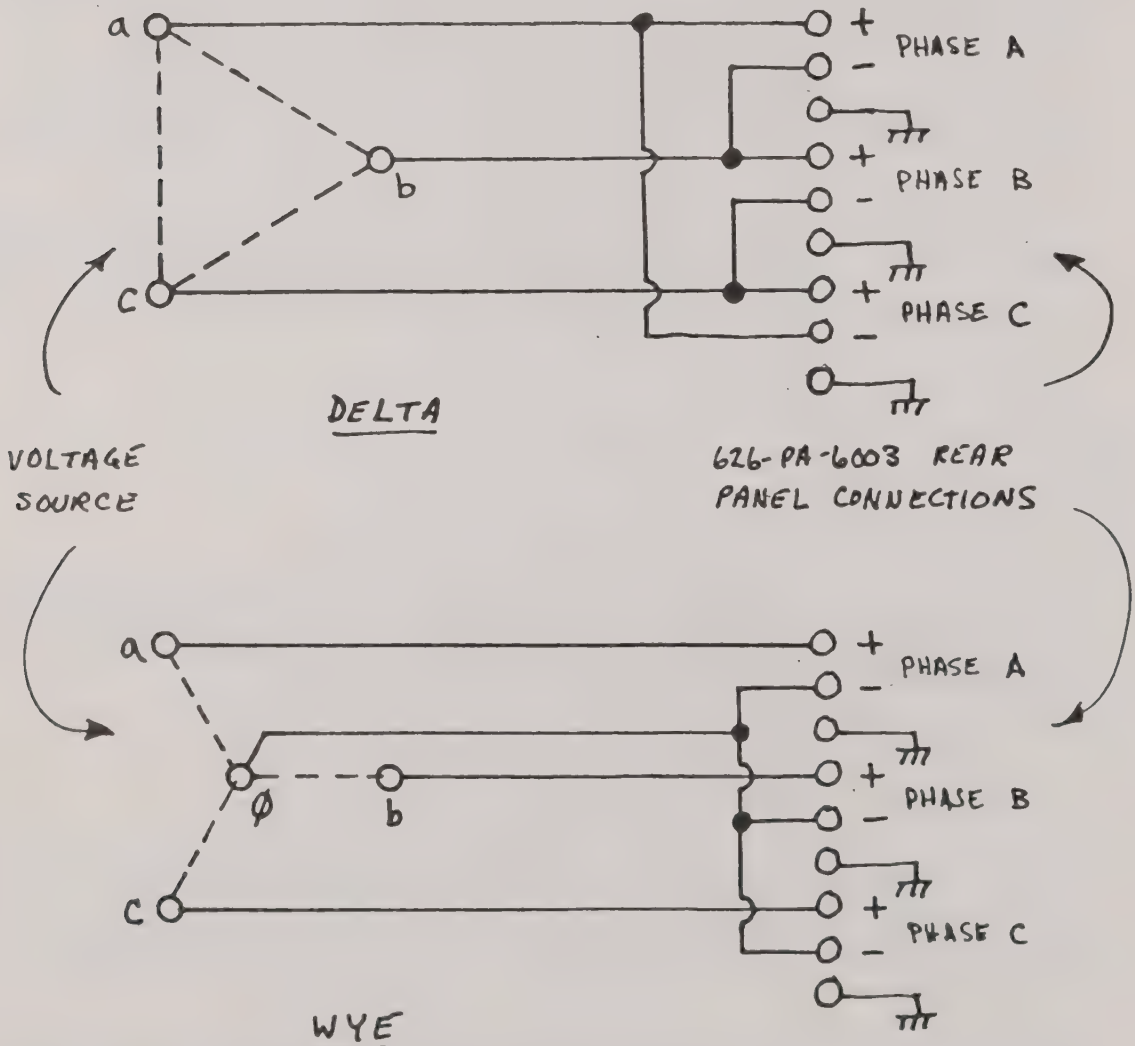
7.2 Programming Procedure

Assume it is desired to program a high limit of 125V, a low limit of 105V, voltage sensitivity of 2 volts, frequency sensitivity of 0.2 Hz and an impulse sensitivity of 25V. Sensitivity sets the deviation from the present value above or below which a detected value produces a recorded disturbance. This is true for both voltage and frequency.

For impulse measurements, the sensitivity corresponds to the absolute threshold, so that an impulse sensitivity of 25 volts, a disturbance is recorded when impulse amplitude rises above 25 volts.

626-PA-6003

SUGGESTED THREE-PHASE CONNECTIONS



Plug-type connector color code:

BLACK to "+" on rear panel
WHITE to "–" on rear panel
GREEN to "⏚" on rear panel

Figure 4.

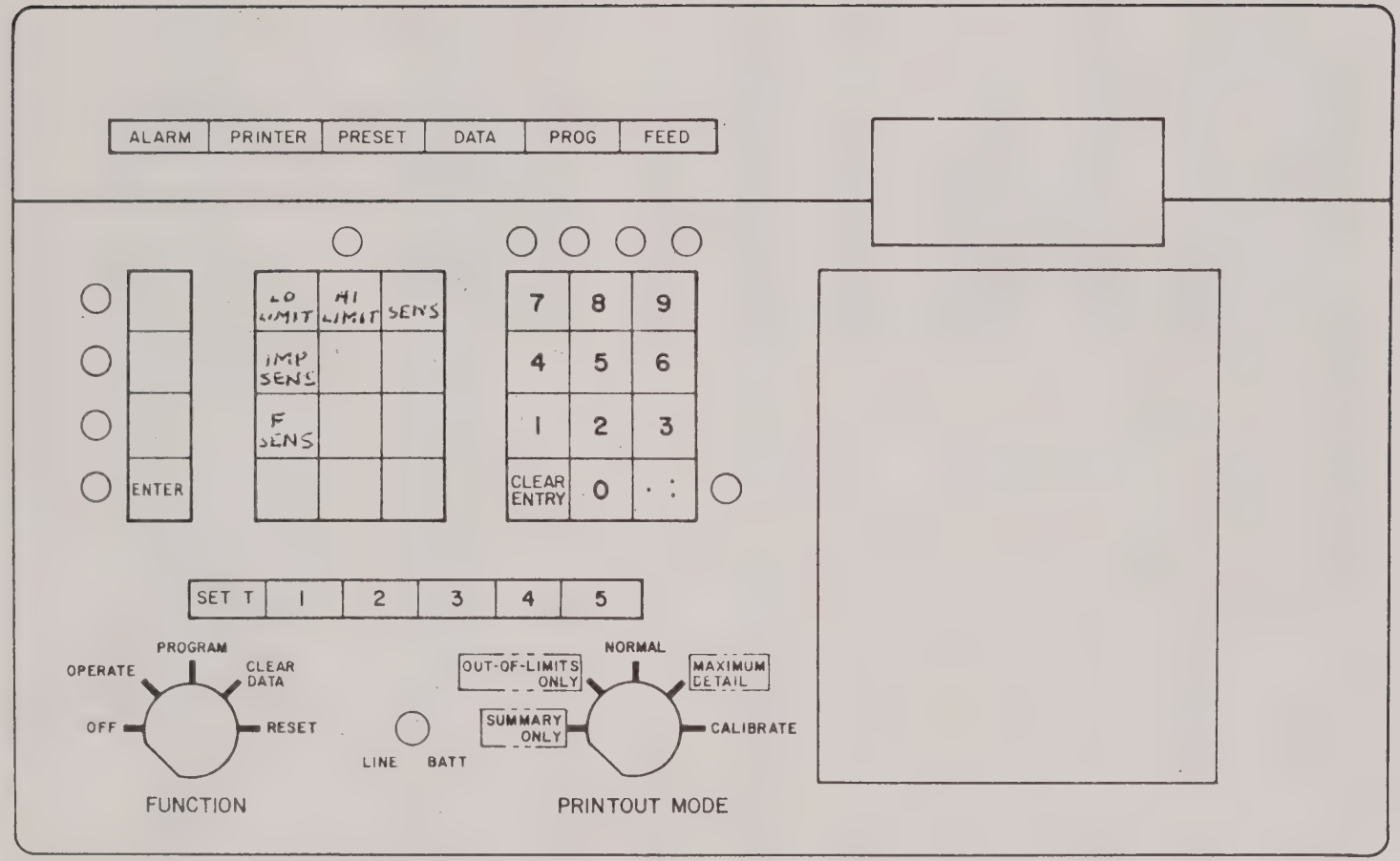


Figure 1. Typical Front Panel with 6003 Installed in Mainframe

TM-110235

Table 2. 6003 Operating Controls

Item	Function
LO LIMIT pushbutton	When depressed, enables numeric keyboard to program low limit voltage.
HI LIMIT pushbutton	When depressed, enables numeric keyboard to program high limit voltage.
SENS pushbutton	When depressed, enables numeric keyboard to program voltage sensitivity value.
IMP SENS pushbutton	When depressed, enables numeric keyboard to program impulse voltage sensitivity value.
F SENS pushbutton	When depressed, enables numeric keyboard to program frequency sensitivity value.
ENTER pushbutton	When depressed, transfers numeric keyboard value into the 6003 memory.
DATA pushbutton	When depressed, produces data summary printout.
PRESET pushbutton	With FUNCTION switch set to PROGRAM and a channel switch (1-5) depressed, depressing PRESET switch recalls nonvolatile factory program for that channel.

For the example cited, program the 6003 as follows:

a. Set FUNCTION switch to PROGRAM.

b. Depress the channel pushbutton (1-5) that corresponds to the slot position of the plug-in to be programmed. Note that a program summary for that channel is immediately printed.

c. Note that a cueing indicator above the center bank of pushbuttons lights. This indicates that a function may be programmed.

d. Depress the HI LIMIT pushbutton. Program the high limit value (125), using the keyboard.

e. When the ENTER indicator lights, depress the ENTER pushbutton. The programmed high limit value will be echoed back on the printout and the ENTER indicator will go out.

f. Repeat steps c, d and e for the low limit voltage (105V) using the LO LIMIT pushbutton.

g. Repeat steps c, d and e for the voltage sensitivity, using the SENS pushbutton and programming the voltage value as 02.

h. Repeat steps c, d and e for the frequency sensitivity (0.2 Hz), using the F SENS pushbutton and programming the value as 0.2.

i. Repeat steps c, d and e for the impulse sensitivity (025 volts), using the IMP SENS pushbutton. The completed program printout should take the following form:

IMPULSE SENS	0025V	
FREQ SENS	00.2 HZ	↑
VOLTAGE SENS	002 V	(Read Up)
V LOW LIMIT	105 V	
V HIGH LIMIT	125 V	
626-PA-6003		
CH 4		

NOTE

The instrument is designed to detect an invalid entry and to automatically shift high and low limits.

j. When the plug-in program is completed, the user may proceed to program another module (by depressing another channel number) or he may place the instrument on line by setting the FUNCTION switch to OPERATE. While on line, the program in effect may be obtained by simply depressing the PROG pushbutton.

8 SELECTING THE FACTORY PRESET PROGRAM

To select the program stored in hard memory, set the FUNCTION switch to PROGRAM and depress the channel number desired. The last operator-set program will be printed out. Now depress the PRESET pushbutton to recall the factory-set program. An example of this sequence appears on the following page.

IMPULSE SENS 0100V
FREQ SENS 00.5 HZ
VOLTAGE SENS 002V
V LOW LIMIT 105 V
V HIGH LIMIT 120 V
626-PA-6001
CH 1
PROGRAM SUMMARY

Factory Program

Press PRESET

IMPULSE SENS 0025V
FREQ SENS 00.2 HZ
VOLTAGE SENS 002 V
V LOW LIMIT 105 V
V HIGH LIMIT 125 V
626-PA-6001
CH 1
PROGRAM SUMMARY

Operator Program

9 DESCRIPTION OF DATA PRINTOUTS

When any of the disturbances described below is detected by the 6003, it is recorded and displayed in characteristic manner.

9.1 Overvoltage

An overvoltage condition exists when the monitored power line voltage exceeds the user-specified upper limit for more than 2.55 seconds. An overvoltage condition is indicated by a printout such as the following:

4B HI 09:46:07.11

where 4 is the channel number, B is the phase and time is given in hours, minutes and seconds (to .01 sec resolution).

When the line voltage recovers to normal, a printout such as the following occurs:

4B NOR 09:46:15.20
148.6 V MAX

indicating when normal voltage was restored and the value of the highest voltage reached during the overvoltage interval.

9.2 Undervoltage

An undervoltage condition exists when the monitored power line voltage remains below the user-specified lower limit for more than 2.55 seconds. An undervoltage condition is indicated by a printout such as the following:

```
4C  LO   09:46:15.20
```

When the line voltage returns to normal level, a message such as the following is printed:

```
↑   4C  NOR   09:46:18.45
|       36.4  V  MIN
```

indicating when normal voltage was restored and the value of the lowest voltage reached during the undervoltage interval.

9.3 Voltage Change

A voltage change printout is triggered when the line voltage changes more than a preselected amount from the last printed value. The voltage change sensitivity is a user-selected integral voltage between one and 15 volts for a 115-volt line. The following example shows several voltage change printouts:

	Printout	Remarks
↑	2C INC 01:02:34.56 115.4 V	Phase C voltage in Channel 2 increased to 115.4V at time shown
|	3A DEC 01:02:34.56 109.2 V	Phase A voltage in Channel 3 decreased to 109.2V at time shown

9.4 Voltage Surge

A Voltage Surge is defined as a line voltage which increases through a user-selected upper limit and then returns to an in-tolerance condition in less than 2.56 seconds. When a surge begins, its starting time is printed as follows:

```
4B  HI   09:45:33.15
```

When the line voltage returns to a normal level following a Surge condition, a message such as the following will be printed:

```
4B  NOR   09:45:33.38
    128.2  V  MAX
    SURGE  0.23 SEC
```

In this case, the time at which the voltage returned to normal is shown as well as the maximum voltage reached and the surge duration.

9.5 Voltage Sag

A Voltage Sag is defined as a line voltage that decreases below the user-selected lower limit and then returns to an in-tolerance condition in less than 2.56 seconds. Sag printouts take the same form as surge printouts, with the term SAG replacing the term SURGE, and the term MIN replacing the term MAX.

NOTE

Voltage inputs less than 25V RMS will be printed out as 0.0V on the 6003.

9.6 Impulses

"Impulse" disturbances represent any line perturbation which contains frequency components in the 300 Hz to 500 kHz range. An impulse type disturbance produces a printout such as the following:

```
2A  IMP  10:12:13.45
    +0139 V,  0010 US
```

This printout indicates that an impulse which deviated from normal line voltage by +139 volts peak and whose duration was 10 microseconds was detected on phase A of Channel 2 at the time shown. Impulse polarity is referenced to "+" and "-" markings on rear panel.

10 CALIBRATE

When the PRINTOUT MODE switch is set to CALIBRATE, a source of precise signals is applied to the front end circuitry of the 6003. Any inputs connected at this time will be automatically disconnected during the calibration period. Successful measurement of these calibration signals fully verify the functionality of the module. Expected calibration measurement results and allowable tolerances are listed below.

AC Voltage	196.0 - 204.0 Volts
Impulse Peak	2700 - 3300 Volts
Impulse Duration	360 - 440 µSec
Frequency	59.8 - 60.2 Hz

11 PRINTOUT MODES

The setting of the PRINTOUT MODE switch on the front panel of the mainframe determines how much detail is printed out. Printout data is reduced as the switch is rotated counterclockwise.

The following example printouts show how various settings of the PRINTOUT MODE switch change the amount of detail in the printed record of a disturbance. It is assumed that the disturbances occurred in phase A of Channel 1 and that the limits for Channel 1 were programmed as follows:

V LOW LIMIT	105 Vrms
V HIGH LIMIT	125 Vrms
V SENSITIVITY	2 Vrms

The example printouts are referenced to figures 2 and 3 which illustrate overvoltage and voltage sag disturbances, respectively.

Disturbances which occur while the PRINTOUT MODE switch is in the SUMMARY ONLY position do not generate individual printouts but they are stored in the daily accumulator and are automatically printed each day at midnight (worst case event and number of occurrences in each category). This printout may also be triggered manually be depressing the DATA button.

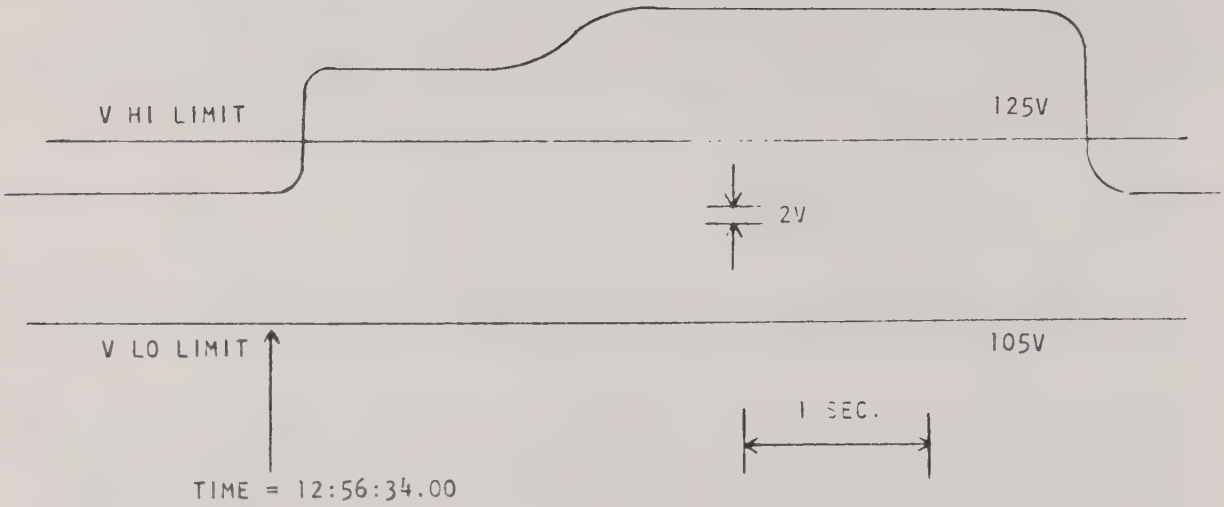


Figure 2. Overvoltage Disturbance (6003)

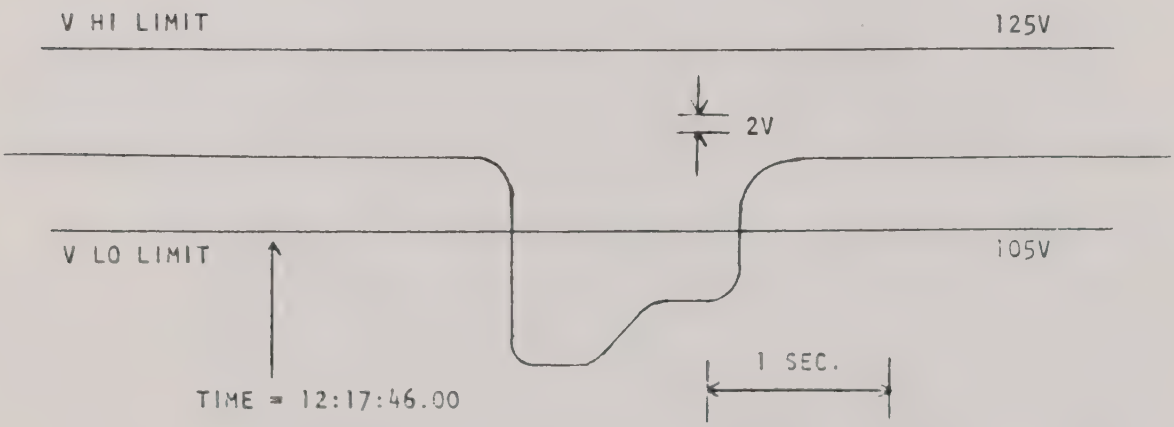


Figure 3. Voltage Sag Disturbance (6003)

```
1A  NOR  12:56:38.51
    139.1 V MAX

1A  HI     12:56:34.21
```

Printout of overvoltage (fig. 2) in OUT-OF LIMITS ONLY mode

(Read Up)

```
1A  NOR  12:56:38.51
    139.1 V Max

1A  DEC  12:56:38.50
    130.2 V

1A  INC  12:56:35.78
    137.3 V

1A  INC  12:56:35.62
    135.3 V

1A  INC  12:56:35.40
    133.3 V

1A  INC  12:56:34.22
    131.3 V

1A  INC  12:56:34.21
    129.2 V

1A  HI     12:56:34.21
```

Printout of overvoltage (fig. 2) in NORMAL mode

1A DEC 12:56:38.61
119.8 V

1A DEC 12:56:38.53
121.8 V

1A DEC 12:56:38.51
124.0 V

1A NOR 12:56:38.51
139.1 V MAX

1A DEC 12:56:38.50
130.2 V

1A INC 12:56:35.78
137.3 V

1A INC 12:56:35.62
135.3 V

1A INC 12:56:35.40
133.3 V

1A INC 12:56:34.22
131.3 V

1A INC 12:56:34.21
129.2 V

1A HI 12:56:34.21

1A INC 12:56:34.20
121.1 V

1A INC 12:50:12.34
119.0 V

(Read Up)

Printout of overvoltage (fig. 2) in MAXIMUM DETAIL mode

```
1A  NOR  12:17:48.61
    090.1 V MIN
    SAG 1.25 SEC

1A  LO   12:17:47.36
```

Printout of voltage sag (fig. 3) in OUT-OF-LIMITS ONLY mode

(Read Up)

```
1A  NOR  12:17:48.61
    090.1 V MIN
    SAG 1.25 SEC

1A  INC  12:17:48.60
    103.1 V

1A  INC  12:17:48.55
    098.0 V

1A  INC  12:17:48.05
    096.0 V

1A  INC  12:17:47.96
    094.0 V

1A  DEC  12:17:47.39
    091.9 V

1A  DEC  12:17:47.37
    094.1 V

1A  DEC  12:17:47.36
    101.3 V

1A  LO   12:17:47.36
```

Printout of voltage sag (fig. 3) in NORMAL mode

```
1A  INC  12:17:48.86
    112.1  V

1A  INC  12:17:48.69
    110.1  V

1A  INC  12:17:48.62
    108.1  V

1A  INC  12:17:48.61
    105.9  V

1A  NOR  12:17:48.61
    090.1  V  MIN
    SAG  1.25  SEC

1A  INC  12:17:48.60
    103.1  V

1A  INC  12:17:48.55
    098.0  V

1A  INC  12:17:48.05
    096.0  V

1A  INC  12:17:47.96
    094.0  V

1A  DEC  12:17:47.39
    091.9  V

1A  DEC  12:17:47.37
    094.1  V

1A  DEC  12:17:47.36
    101.3  V

1A  LO   12:17:47.36

1A  DEC  12:17:47.35
    110.8  V

1A  INC  12:16:32.15
    113.0  V
```

(Read Up)

Printout of voltage sag (fig. 3) in MAXIMUM DETAIL mode

12 626 Module Capacity

The 626 standard mainframe has an upper limit of the total load rating of the installed modules. The overall mainframe capacity is set at 13 units, and individual modules have load ratings as follows:

Plug-in	Load Rating
626-PA-6001	2 Units
626-PA-6001 With Extra Option Board	3 Units
626-PA-6002	2 Units
626-PA-6003	4 Units
626-PA-6006	2 Units
626-PA-6007	1 Unit
626-PA-6011	1 Unit
(626-PA-6012)	3 Units

When selecting modules for installation in any mainframe, simply verify that the sum of the load ratings of the installed modules does not exceed 13.

13 Standard Accessories

Model No.	Part No.	Quan.	Description
626PA6003-1 (Barrier Block Connections)	TM110235	1	Operating Manual
626PA6003-2 (Plug-type Connections)	TM110235	1	Operating Manual
	110480-G1	3	A.C. Cables

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1001380

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RESULT IN A
$50

TM-110235 (REV. A)

VOLUME I

OPERATOR'S MANUAL

626-PA-6003

3-PHASE AC MONITOR

1 October 1981

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Upper Limit of User-Set Voltage (V_{HIGH})	600V to 51V
Voltage Change Sensitivity (V_{SENS}) (1V Increments)	2 to 60V
Line Voltage Measurement Resolution	0.2V

Table 1. 626-PA-6003 Technical Specifications (Cont'd.)

Line Voltage Measurement Accuracy	±1% of reading, ±0.2% of full scale (75V to 600V)
Line Frequency	
Range	45 - 65 Hz
Resolution	±0.1 Hz
Accuracy	±0.1 Hz
Impulse Range	25 -4000V Pk (1-2000 uSec)
Impulse Peak Resolution	1 V
Impulse Accuracy	±10% of reading ±1%F.S. (5μSec-50μSec.) (decreasing to ±6db from 1μSec to 2mSec) 100V-4000V
Impulse Duration Range	1 uSec to 2 mSec
Impulse Duration Resolution	1 uSec

5 INSTALLATION

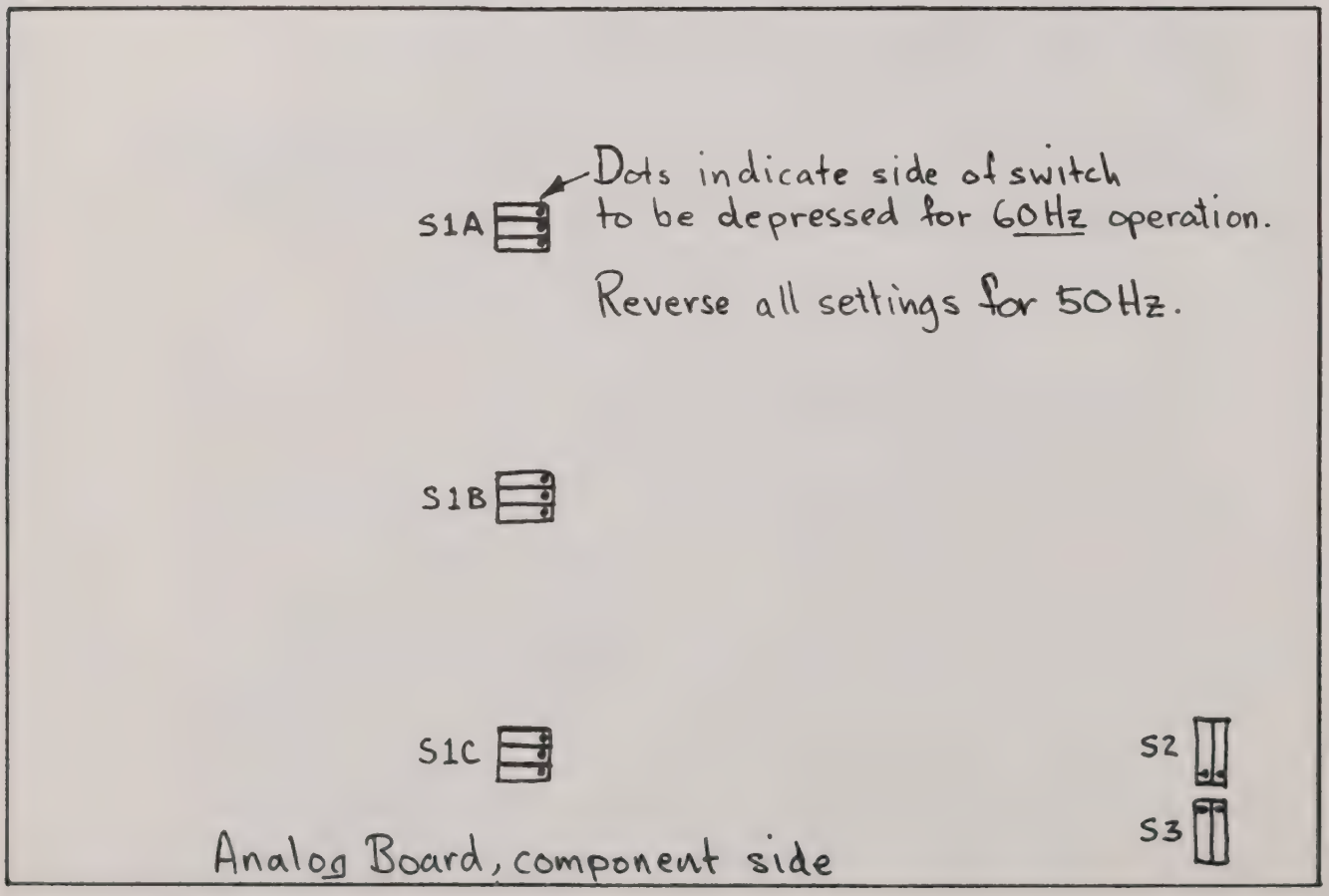
5.1 Selection of Nominal Operating Frequency

The 6003 has switches which are factory set so that measurements are optimized for a nominal frequency of either 50 or 60 Hz. Figure below shows the location of these switches on the Analog board of the module. Dots on switches on the figure indicate which side of the switch is to be depressed for 60Hz. For 50 Hz operation, simply reverse all switches.

5.2 Installation of 6003 in Mainframe

Do not attempt to install a 6003 module in slot 5 of the 626 mainframe. Slots 1-4 may be used, as follows:

a. With the rear panel markings reading correctly, carefully slide the module into the desired slot, with the Digital board within the card-guide tracks, until it is firmly seated.
b. Tighten the top and bottom captive screws to secure the module into the mainframe.



6 CONNECTING POWER SOURCE TO MODULE (See Figure 4)

The 6003 is equipped with three rear panel AC connectors, one each for phase A, B, and C. Mating connectors are supplied for the user. The 3-wire mating connectors must be wired in accordance with the rear panel connector markings (AC high, AC low, and earth ground from top to bottom).

a. Insert key in FUNCTION key switch on front panel of mainframe and set switch to OFF position.

b. Turn off AC power source that is to be used to power the module.

c. Attach the wired mating connector to the rear panel connector, then reapply AC power.

CAUTION

To avoid damaging the equipment, do not apply AC voltages in excess of 600V RMS to any AC phase (A, B, or C) applied to the 6003.

7 OPERATING THE 6003

7.1 Operating Controls and Indicators

The functions of the mainframe operating controls and indicators associated with 6003 operation are described in Table 2. Figure 1 shows the typical front panel controls on a Model 626 that are associated with a 6003 module. For a description of controls common to overall Model 626 operation, refer to TM-106650.

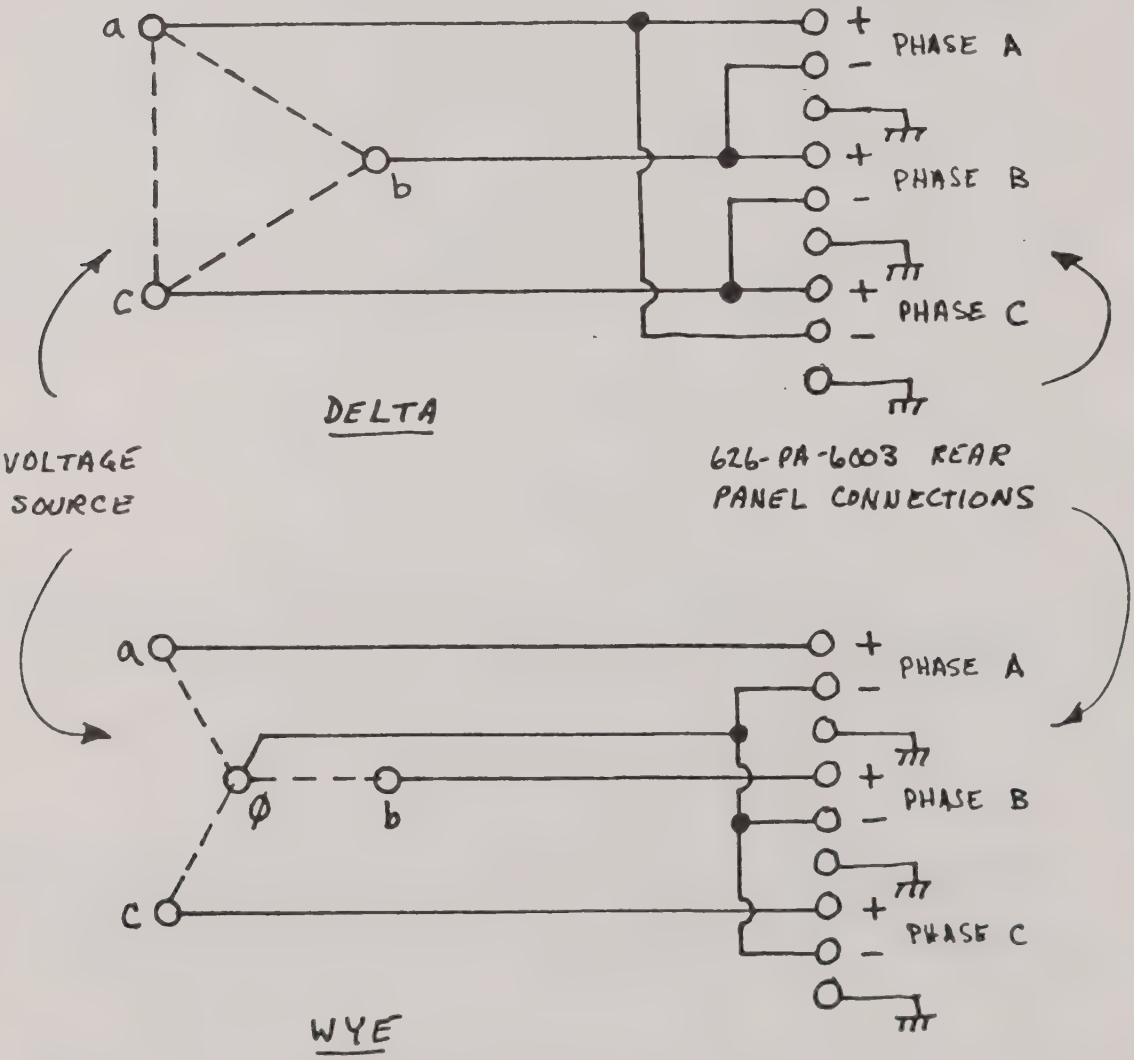
7.2 Programming Procedure

Assume it is desired to program a high limit of 125V, a low limit of 105V, voltage sensitivity of 2 volts, frequency sensitivity of 0.2 Hz and an impulse sensitivity of 25V. Sensitivity sets the deviation from the present value above or below which a detected value produces a recorded disturbance. This is true for both voltage and frequency.

For impulse measurements, the sensitivity corresponds to the absolute threshold, so that an impulse sensitivity of 25 volts, a disturbance is recorded when impulse amplitude rises above 25 volts.

626-PA-6003

SUGGESTED THREE-PHASE CONNECTIONS



Plug-type connector color code:

BLACK to "+" on rear panel
WHITE to "–" on rear panel
GREEN to "⏚" on rear panel

Figure 4.

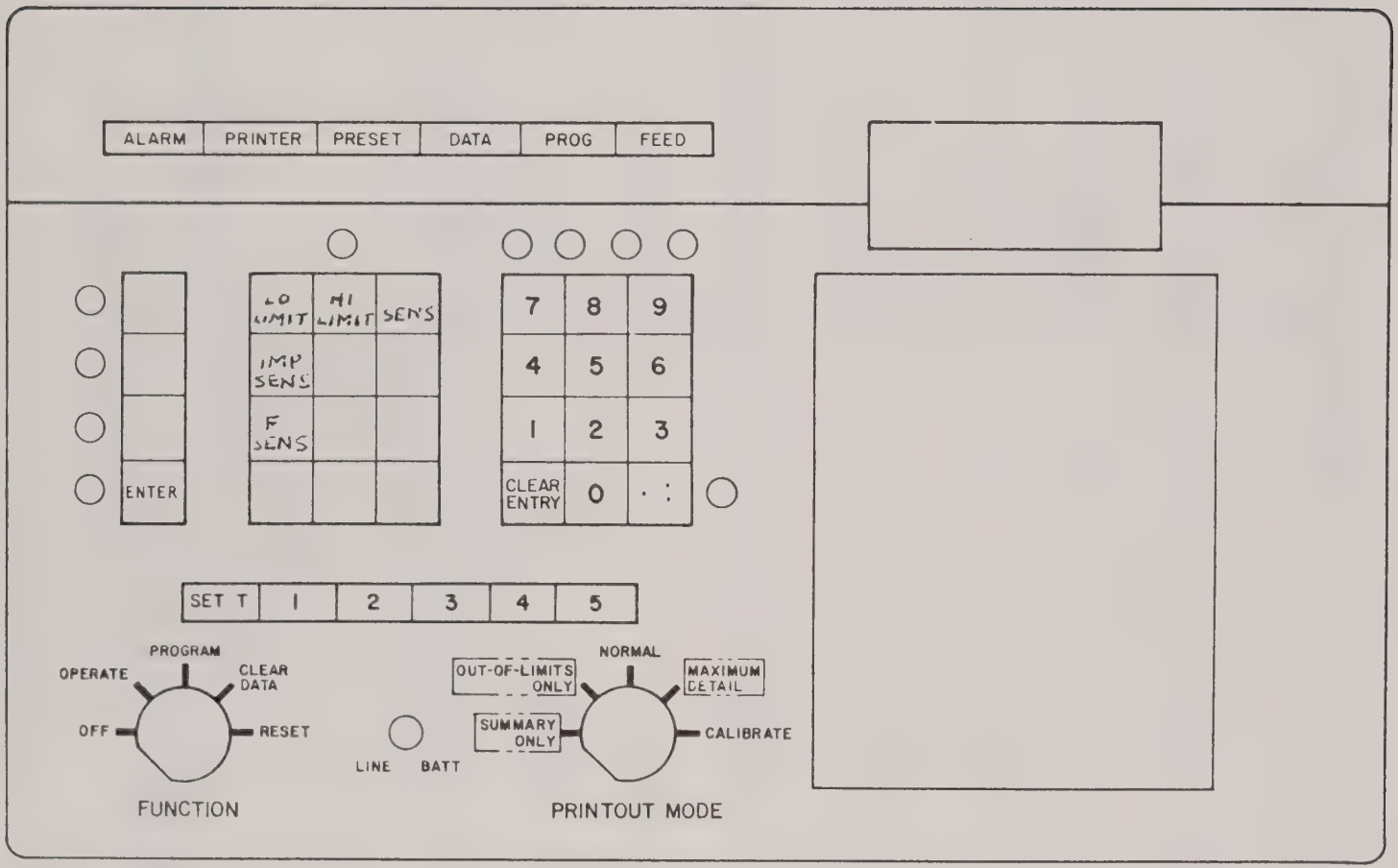


Figure 1. Typical Front Panel with 6003 Installed in Mainframe

Table 2. 6003 Operating Controls

Item	Function
LO LIMIT pushbutton	When depressed, enables numeric keyboard to program low limit voltage.
HI LIMIT pushbutton	When depressed, enables numeric keyboard to program high limit voltage.
SENS pushbutton	When depressed, enables numeric keyboard to program voltage sensitivity value.
IMP SENS pushbutton	When depressed, enables numeric keyboard to program impulse voltage sensitivity value.
F SENS pushbutton	When depressed, enables numeric keyboard to program frequency sensitivity value.
ENTER pushbutton	When depressed, transfers numeric keyboard value into the 6003 memory.
DATA pushbutton	When depressed, produces data summary printout.
PRESET pushbutton	With FUNCTION switch set to PROGRAM and a channel switch (1-5) depressed, depressing PRESET switch recalls nonvolatile factory program for that channel.

For the example cited, program the 6003 as follows:

a. Set FUNCTION switch to PROGRAM.

b. Depress the channel pushbutton (1-5) that corresponds to the slot position of the plug-in to be programmed. Note that a program summary for that channel is immediately printed.

c. Note that a cueing indicator above the center bank of pushbuttons lights. This indicates that a function may be programmed.

d. Depress the HI LIMIT pushbutton. Program the high limit value (125), using the keyboard.

e. When the ENTER indicator lights, depress the ENTER pushbutton. The programmed high limit value will be echoed back on the printout and the ENTER indicator will go out.

f. Repeat steps c, d and e for the low limit voltage (105V) using the LO LIMIT pushbutton.

g. Repeat steps c, d and e for the voltage sensitivity, using the SENS pushbutton and programming the voltage value as 02.

h. Repeat steps c, d and e for the frequency sensitivity (0.2 Hz), using the F SENS pushbutton and programming the value as 0.2.

i. Repeat steps c, d and e for the impulse sensitivity (025 volts), using the IMP SENS pushbutton. The completed program printout should take the following form:

IMPULSE SENS	0025V	
FREQ SENS	00.2 HZ	↑
VOLTAGE SENS	002 V	(Read Up)
V LOW LIMIT	105 V	
V HIGH LIMIT	125 V	

626-PA-6003
CH 4

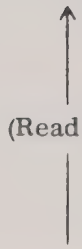
NOTE

The instrument is designed to detect an invalid entry and to automatically shift high and low limits.

j. When the plug-in program is completed, the user may proceed to program another module (by depressing another channel number) or he may place the instrument on line by setting the FUNCTION switch to OPERATE. While on line, the program in effect may be obtained by simply depressing the PROG pushbutton.

8 SELECTING THE FACTORY PRESET PROGRAM

To select the program stored in hard memory, set the FUNCTION switch to PROGRAM and depress the channel number desired. The last operator-set program will be printed out. Now depress the PRESET pushbutton to recall the factory-set program. An example of this sequence appears on the following page.



IMPULSE SENS 0100V
FREQ SENS 00.5 HZ
VOLTAGE SENS 002V
V LOW LIMIT 105 V
V HIGH LIMIT 120 V
626-PA-6001
CH 1
PROGRAM SUMMARY

Factory Program

Press PRESET

IMPULSE SENS 0025V
FREQ SENS 00.2 HZ
VOLTAGE SENS 002 V
V LOW LIMIT 105 V
V HIGH LIMIT 125 V
626-PA-6001
CH 1
PROGRAM SUMMARY

Operator Program

9 DESCRIPTION OF DATA PRINTOUTS

When any of the disturbances described below is detected by the 6003, it is recorded and displayed in characteristic manner.

9.1 Overvoltage

An overvoltage condition exists when the monitored power line voltage exceeds the user-specified upper limit for more than 2.55 seconds. An overvoltage condition is indicated by a printout such as the following:

4B HI 09:46:07.11

where 4 is the channel number, B is the phase and time is given in hours, minutes and seconds (to .01 sec resolution).

When the line voltage recovers to normal, a printout such as the following occurs:

4B NOR 09:46:15.20
148.6 V MAX

indicating when normal voltage was restored and the value of the highest voltage reached during the overvoltage interval.

9.2 Undervoltage

An undervoltage condition exists when the monitored power line voltage remains below the user-specified lower limit for more than 2.55 seconds. An undervoltage condition is indicated by a printout such as the following:

```
4C  LO   09:46:15.20
```

When the line voltage returns to normal level, a message such as the following is printed:

```
4C  NOR  09:46:18.45
    36.4 V MIN
```

indicating when normal voltage was restored and the value of the lowest voltage reached during the undervoltage interval.

9.3 Voltage Change

A voltage change printout is triggered when the line voltage changes more than a preselected amount from the last printed value. The voltage change sensitivity is a user-selected integral voltage between one and 15 volts for a 115-volt line. The following example shows several voltage change printouts:

Printout	Remarks
2C INC 01:02:34.56 115.4 V	Phase C voltage in Channel 2 increased to 115.4V at time shown
3A DEC 01:02:34.56 109.2 V	Phase A voltage in Channel 3 decreased to 109.2V at time shown

9.4 Voltage Surge

A Voltage Surge is defined as a line voltage which increases through a user-selected upper limit and then returns to an in-tolerance condition in less than 2.56 seconds. When a surge begins, its starting time is printed as follows:

```
4B  HI   09:45:33.15
```

When the line voltage returns to a normal level following a Surge condition, a message such as the following will be printed:

```
4B  NOR  09:45:33.38
    128.2 V MAX
    SURGE 0.23 SEC
```

In this case, the time at which the voltage returned to normal is shown as well as the maximum voltage reached and the surge duration.

9.5 Voltage Sag

A Voltage Sag is defined as a line voltage that decreases below the user-selected lower limit and then returns to an in-tolerance condition in less than 2.56 seconds. Sag printouts take the same form as surge printouts, with the term SAG replacing the term SURGE, and the term MIN replacing the term MAX.

NOTE

Voltage inputs less than 25V RMS will be printed out as 0.0V on the 6003.

9.6 Impulses

"Impulse" disturbances represent any line perturbation which contains frequency components in the 300 Hz to 500 kHz range. An impulse type disturbance produces a printout such as the following:

```
2A  IMP  10:12:13.45
    +0139 V,  0010 US
```

This printout indicates that an impulse which deviated from normal line voltage by +139 volts peak and whose duration was 10 microseconds was detected on phase A of Channel 2 at the time shown. Impulse polarity is referenced to "+" and "-" markings on rear panel.

10 CALIBRATE

When the PRINTOUT MODE switch is set to CALIBRATE, a source of precise signals is applied to the front end circuitry of the 6003. Any inputs connected at this time will be automatically disconnected during the calibration period. Successful measurement of these calibration signals fully verify the functionality of the module. Expected calibration measurement results and allowable tolerances are listed below.

AC Voltage	196.0 - 204.0 Volts
Impulse Peak	2700 - 3300 Volts
Impulse Duration	360 - 440 µSec
Frequency	59.8 - 60.2 Hz

11 PRINTOUT MODES

The setting of the PRINTOUT MODE switch on the front panel of the mainframe determines how much detail is printed out. Printout data is reduced as the switch is rotated counterclockwise.

The following example printouts show how various settings of the PRINTOUT MODE switch change the amount of detail in the printed record of a disturbance. It is assumed that the disturbances occurred in phase A of Channel 1 and that the limits for Channel 1 were programmed as follows:

V LOW LIMIT	105 Vrms
V HIGH LIMIT	125 Vrms
V SENSITIVITY	2 Vrms

The example printouts are referenced to figures 2 and 3 which illustrate overvoltage and voltage sag disturbances, respectively.

Disturbances which occur while the PRINTOUT MODE switch is in the SUMMARY ONLY position do not generate individual printouts but they are stored in the daily accumulator and are automatically printed each day at midnight (worst case event and number of occurrences in each category). This printout may also be triggered manually be depressing the DATA button.

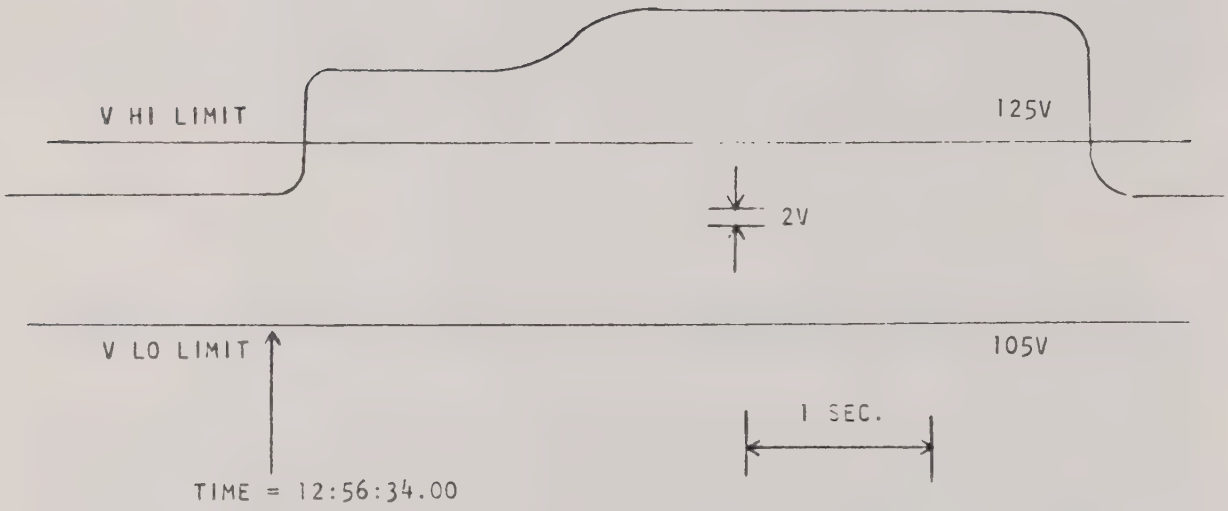


Figure 2. Overvoltage Disturbance (6003)

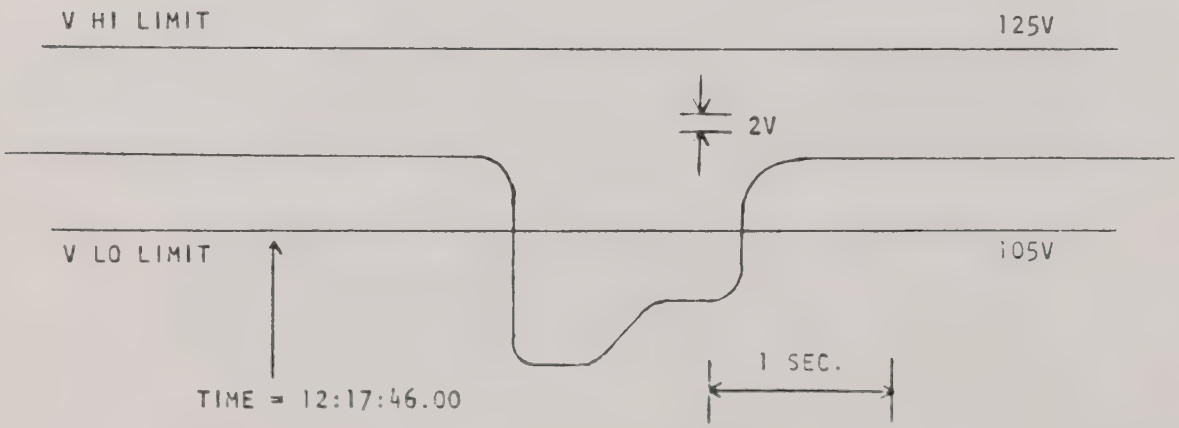


Figure 3. Voltage Sag Disturbance (6003)

1A NOR 12:56:38.51
139.1 V MAX

1A HI 12:56:34.21

Printout of overvoltage (fig. 2) in OUT-OF LIMITS ONLY mode

(Read Up)

1A NOR 12:56:38.51
139.1 V Max

1A DEC 12:56:38.50
130.2 V

1A INC 12:56:35.78
137.3 V

1A INC 12:56:35.62
135.3 V

1A INC 12:56:35.40
133.3 V

1A INC 12:56:34.22
131.3 V

1A INC 12:56:34.21
129.2 V

1A HI 12:56:34.21

Printout of overvoltage (fig. 2) in NORMAL mode

```
1A  DEC  12:56:38.61
    119.8  V

1A  DEC  12:56:38.53
    121.8  V

1A  DEC  12:56:38.51
    124.0  V

1A  NOR  12:56:38.51
    139.1  V  MAX

1A  DEC  12:56:38.50
    130.2  V

1A  INC  12:56:35.78
    137.3  V

1A  INC  12:56:35.62
    135.3  V

1A  INC  12:56:35.40
    133.3  V

1A  INC  12:56:34.22
    131.3  V

1A  INC  12:56:34.21
    129.2  V

1A  HI     12:56:34.21

1A  INC  12:56:34.20
    121.1  V

1A  INC  12:50:12.34
    119.0  V
```

(Read Up)

Printout of overvoltage (fig. 2) in MAXIMUM DETAIL mode

```
1A  NOR  12:17:48.61
    090.1 V MIN
    SAG 1.25 SEC

1A  LO   12:17:47.36
```

Printout of voltage sag (fig. 3) in OUT-OF-LIMITS ONLY mode

(Read Up)

```
1A  NOR  12:17:48.61
    090.1 V MIN
    SAG 1.25 SEC

1A  INC  12:17:48.60
    103.1 V

1A  INC  12:17:48.55
    098.0 V

1A  INC  12:17:48.05
    096.0 V

1A  INC  12:17:47.96
    094.0 V

1A  DEC  12:17:47.39
    091.9 V

1A  DEC  12:17:47.37
    094.1 V

1A  DEC  12:17:47.36
    101.3 V

1A  LO   12:17:47.36
```

Printout of voltage sag (fig. 3) in NORMAL mode

```
1A  INC  12:17:48.86
    112.1 V

1A  INC  12:17:48.69
    110.1 V

1A  INC  12:17:48.62
    108.1 V

1A  INC  12:17:48.61
    105.9 V

1A  NOR  12:17:48.61
    090.1 V MIN
    SAG  1.25  SEC

1A  INC  12:17:48.60
    103.1 V

1A  INC  12:17:48.55
    098.0 V

1A  INC  12:17:48.05
    096.0 V

1A  INC  12:17:47.96
    094.0 V

1A  DEC  12:17:47.39
    091.9 V

1A  DEC  12:17:47.37
    094.1 V

1A  DEC  12:17:47.36
    101.3 V

1A  LO   12:17:47.36

1A  DEC  12:17:47.35
    110.8 V

1A  INC  12:16:32.15
    113.0 V
```

(Read Up)

Printout of voltage sag (fig. 3) in MAXIMUM DETAIL mode

12 626 Module Capacity

The 626 standard mainframe has an upper limit of the total load rating of the installed modules. The overall mainframe capacity is set at 13 units, and individual modules have load ratings as follows:

Plug-in	Load Rating
626-PA-6001	2 Units
626-PA-6001 With Extra Option Board	3 Units
626-PA-6002	2 Units
626-PA-6003	4 Units
626-PA-6006	2 Units
626-PA-6007	1 Unit
626-PA-6011	1 Unit
(626-PA-6012)	3 Units

When selecting modules for installation in any mainframe, simply verify that the sum of the load ratings of the installed modules does not exceed 13.

13 Standard Accessories

Model No.	Part No.	Quan.	Description
626PA6003-1 (Barrier Block Connections)	TM110235	1	Operating Manual
626PA6003-2	TM110235	1	Operating Manual
	110480-G1	3	A.C. Cables
(Plug-type Connections)			

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WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electrical Code (ANSI C1) and/or any other requirements which may be applicable to the user.

Installation, operation, and maintenance should be performed only by qualified personnel.

(REV. A)

TM-110235

VOLUME I

OPERATOR'S MANUAL

626-PA-6003

3-PHASE AC MONITOR

1 October 1981

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DRANETZ

DRANETZ ENGINEERING LABORATORIES, INCORPORATED
1000 New Durham Road, CN-91, Edison, N.J. 08818

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626-PA-6003 3-PHASE AC MONITOR

1 INTRODUCTION

This manual provides instructions for the 626-PA-6003 Plug-in, hereinafter referred to as the 6003, used in the Model 626 Universal Disturbance Analyzer. It is assumed that the reader is familiar with the mainframe information described in TM-106650.

2 PURPOSE

The 6003 monitors disturbances on 3-phase AC power lines. Each phase is monitored on a single voltage range of 0 to 600V RMS. With thresholds programmed by the user, the 6003 monitors both short and long term power line disturbances. With this plug-in, the unit stores, analyzes, classifies and prints out quantative and qualitative disturbance data. Accompanying the data is a printout of time derived from a highly accurate crystal-controlled 24-hour clock in the mainframe.

The plug-in monitors any 3-phase power line whose RMS values range from a low value of 0 volts to as high as 600 volts. Three types of disturbances are monitored by the 6003: power line frequency, power frequency transients and waveform disturbances. Power frequency transients are divided into five display categories: overvoltage, undervoltage, voltage change, voltage surge and voltage sag. Waveform disturbances, identified as "impulses," include all conditions that cause the power line waveform to deviate from an ideal waveform. The 6003 measures the peak amplitude of impulses, their polarity and duration. The threshold value of each type of disturbance, as well as the line frequency, above which detection and printout occurs is operator programmable. (All threshold settings are common to all three line phases.) Except for an automatic summary printout at the end of each day, disturbance data is normally printed out only when disturbances occur. In an alternate mode, a disturbance data summary printout occurs only at the end of each day. This feature permits long term unattended operation.

The threshold program may be easily altered, using the front panel switches. Cueing indicators adjacent to the programming switches simplify the programming procedure. A back-up program for the plug-in, stored in hard memory at the factory, may always be recalled upon operator demand. Both the program and the disturbance data in the data accumulators may be printed out upon demand.

NOTE: Frequency measurements are derived from phase A only. Therefore, if single-phase monitoring is desired, phase A should be used.

3 APPLICATIONS

When installed in the 626 mainframe, the 6003 provides the capability of monitoring and evaluating power system performance. Among its typical applications are the following:

a. To determine the effect of power systems operation on equipment malfunction. The time-referenced power fault disturbance record produced by the instrument permits rapid correlation of errors, outages, and equipment damage in computer, industrial process controls, digital communications equipment, medical monitoring apparatus, and so forth, to power line faults.

b. To perform pre-installation site surveys. The 6003 can be used to determine the adequacy of existing power lines intended to support critical electrical equipment. Anticipation of power problems saves time, money, and future trouble.

c. For diagnostic evaluation of power system performance. The portable instrument, particularly well suited for field use, is ideal for determining the probable causes of, and remedies for, power line disturbances.

d. For monitoring life test racks. The printout produced by the instrument provides a clear record of the quality of power supplied during unattended periods.

4 EQUIPMENT CHARACTERISTICS

The 6003 is configured as a plug-in module 6.5" high by 1.25" wide by 10" deep. It is designed for installation in one of four slots of the Model 626 Universal Disturbance Analyzer. Technical specifications of the 6003 are presented in Table 1.

Table 1. 626-PA-6003 Technical Specifications

Input	2 wire differential Z_{in} = 40 Megohms plus 40 pf (each side to ground)
Input Voltage Range	0-600V RMS
Lower Limit of User-Set Voltage (V_{LOW})	50V to 599V
Upper Limit of User-Set Voltage (V_{HIGH})	600V to 51V
Voltage Change Sensitivity (V_{SENS}) (1V Increments)	2 to 60V
Line Voltage Measurement Resolution	0.2V

Table 1. 626-PA-6003 Technical Specifications (Cont'd.)

Line Voltage Measurement Accuracy	±1% of reading, ±0.2% of full scale (75V to 600V)
Line Frequency	
Range	45 - 65 Hz
Resolution	±0.1 Hz
Accuracy	±0.1 Hz
Impulse Range	25 -4000V Pk (1-2000 uSec)
Impulse Peak Resolution	1 V
Impulse Accuracy	±10% of reading ±1%F.S. (5μSec-50μSec.) (decreasing to ±6db from 1μSec to 2mSec) 100V-4000V
Impulse Duration Range	1 uSec to 2 mSec
Impulse Duration Resolution	1 uSec

5 INSTALLATION

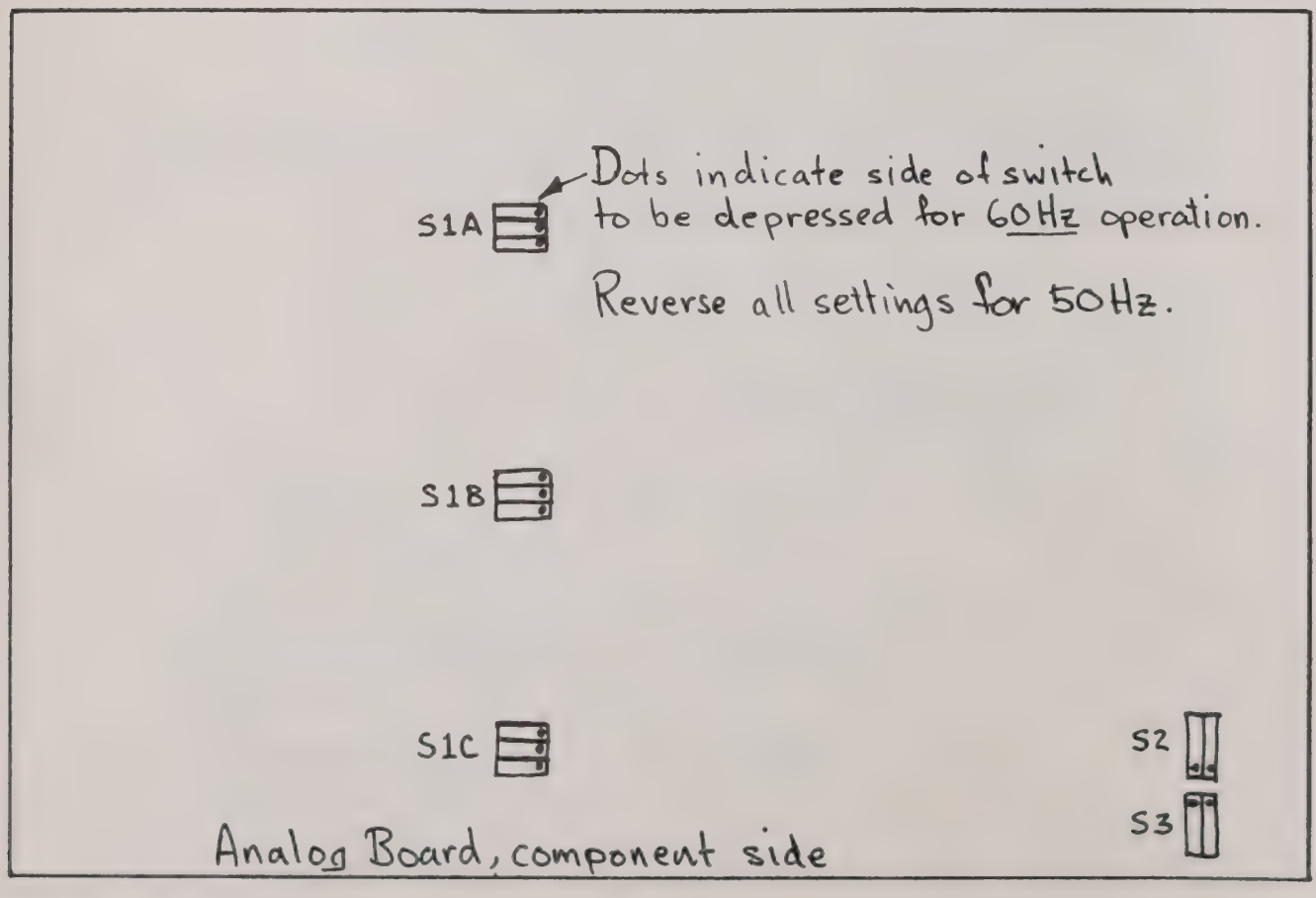
5.1 Selection of Nominal Operating Frequency

The 6003 has switches which are factory set so that measurements are optimized for a nominal frequency of either 50 or 60 Hz. Figure below shows the location of these switches on the Analog board of the module. Dots on switches on the figure indicate which side of the switch is to be depressed for 60Hz. For 50 Hz operation, simply reverse all switches.

5.2 Installation of 6003 in Mainframe

Do not attempt to install a 6003 module in slot 5 of the 626 mainframe. Slots 1-4 may be used, as follows:

a. With the rear panel markings reading correctly, carefully slide the module into the desired slot, with the Digital board within the card-guide tracks, until it is firmly seated.
b. Tighten the top and bottom captive screws to secure the module into the mainframe.



6 CONNECTING POWER SOURCE TO MODULE (See Figure 4)

The 6003 is equipped with three rear panel AC connectors, one each for phase A, B, and C. Mating connectors are supplied for the user. The 3-wire mating connectors must be wired in accordance with the rear panel connector markings (AC high, AC low, and earth ground from top to bottom).

a. Insert key in FUNCTION key switch on front panel of mainframe and set switch to OFF position.

b. Turn off AC power source that is to be used to power the module.

c. Attach the wired mating connector to the rear panel connector, then reapply AC power.

CAUTION

To avoid damaging the equipment, do not apply AC voltages in excess of 600V RMS to any AC phase (A, B, or C) applied to the 6003.

7 OPERATING THE 6003

7.1 Operating Controls and Indicators

The functions of the mainframe operating controls and indicators associated with 6003 operation are described in Table 2. Figure 1 shows the typical front panel controls on a Model 626 that are associated with a 6003 module. For a description of controls common to overall Model 626 operation, refer to TM-106650.

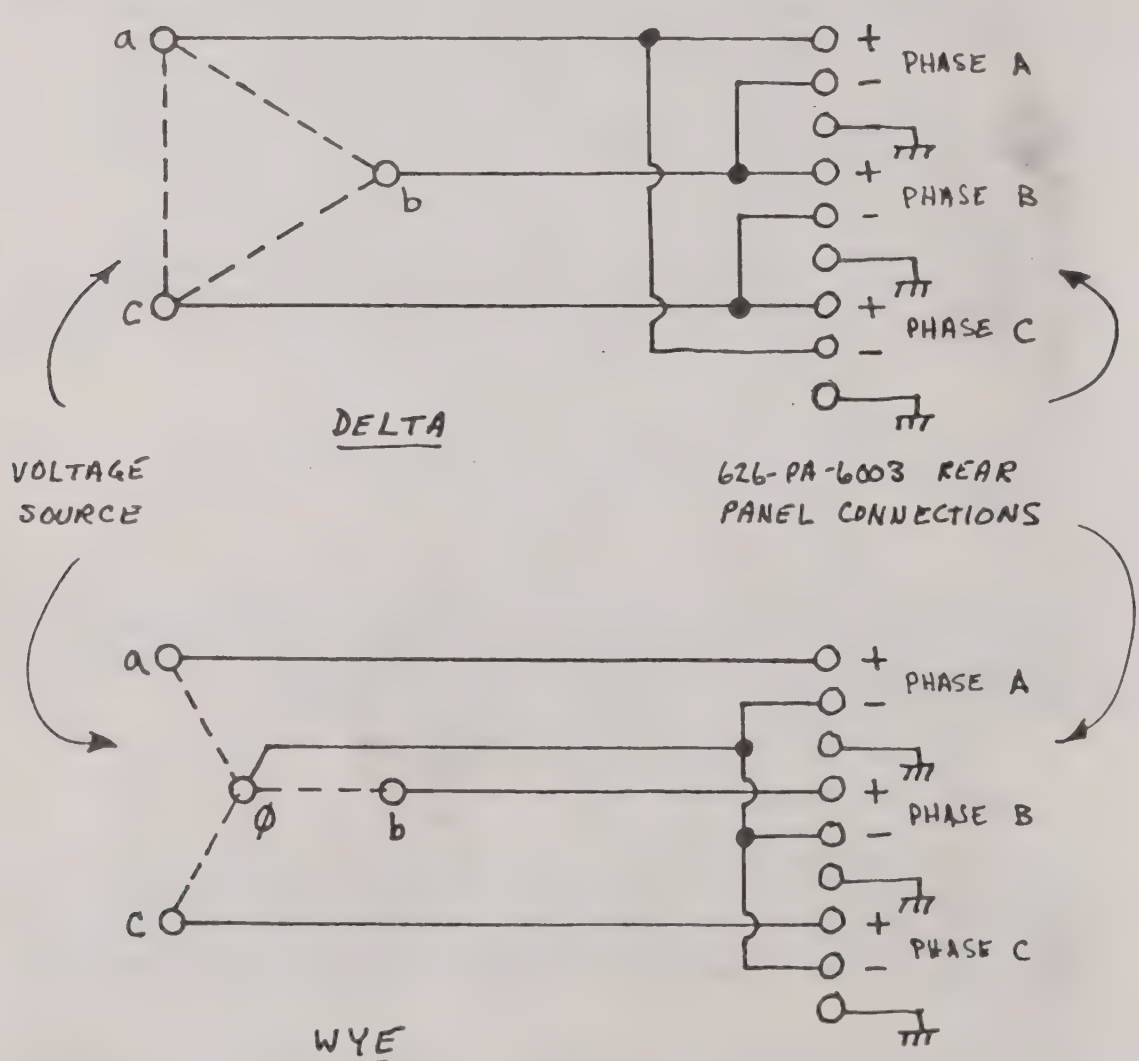
7.2 Programming Procedure

Assume it is desired to program a high limit of 125V, a low limit of 105V, voltage sensitivity of 2 volts, frequency sensitivity of 0.2 Hz and an impulse sensitivity of 25V. Sensitivity sets the deviation from the present value above or below which a detected value produces a recorded disturbance. This is true for both voltage and frequency.

For impulse measurements, the sensitivity corresponds to the absolute threshold, so that an impulse sensitivity of 25 volts, a disturbance is recorded when impulse amplitude rises above 25 volts.

626-PA-6003

SUGGESTED THREE-PHASE CONNECTIONS



Plug-type connector color code:

BLACK to "+" on rear panel
WHITE to "–" on rear panel
GREEN to "⏚" on rear panel

Figure 4.

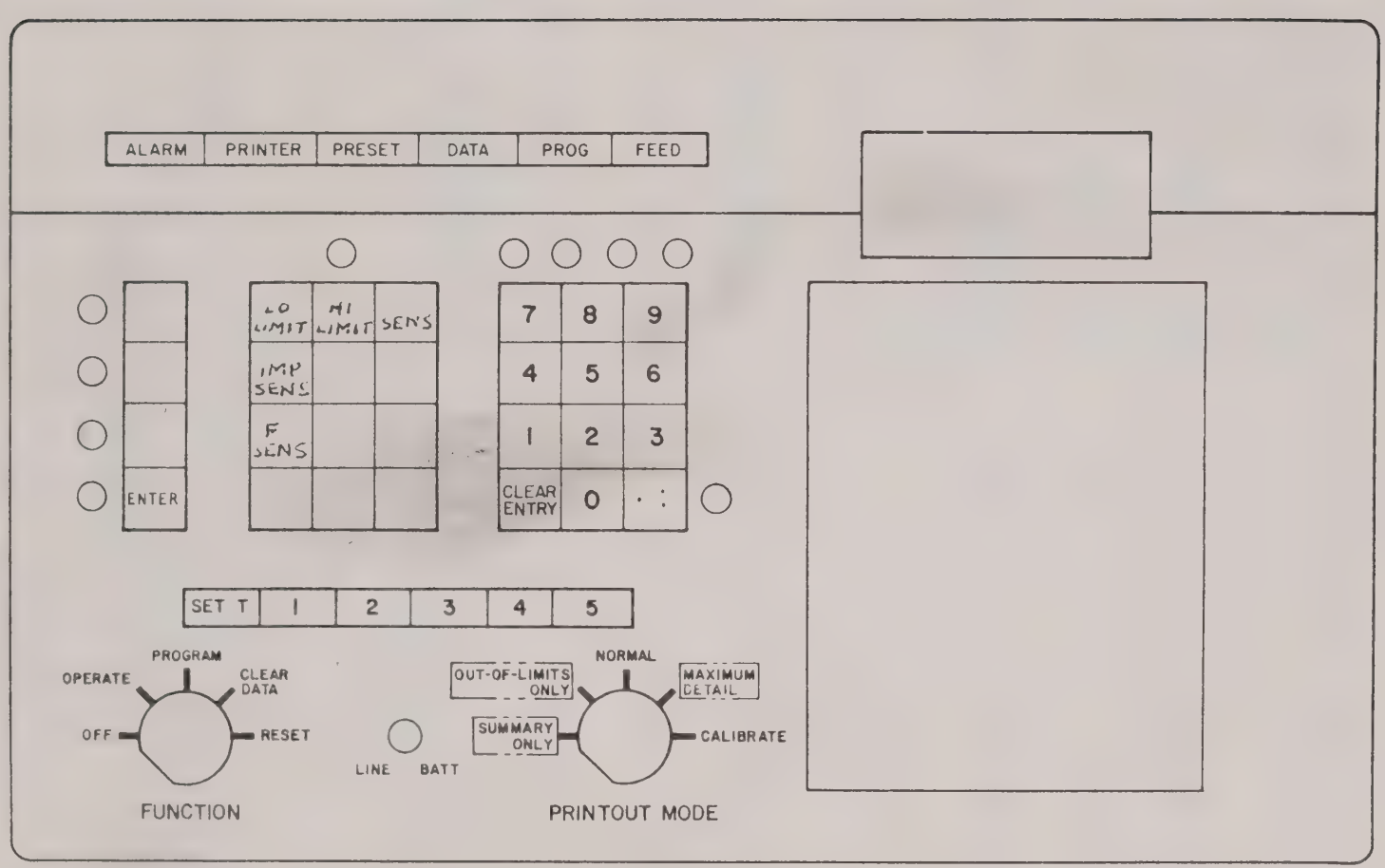


Figure 1. Typical Front Panel with 6003 Installed in Mainframe

Table 2. 6003 Operating Controls

Item	Function
LO LIMIT pushbutton	When depressed, enables numeric keyboard to program low limit voltage.
HI LIMIT pushbutton	When depressed, enables numeric keyboard to program high limit voltage.
SENS pushbutton	When depressed, enables numeric keyboard to program voltage sensitivity value.
IMP SENS pushbutton	When depressed, enables numeric keyboard to program impulse voltage sensitivity value.
F SENS pushbutton	When depressed, enables numeric keyboard to program frequency sensitivity value.
ENTER pushbutton	When depressed, transfers numeric keyboard value into the 6003 memory.
DATA pushbutton	When depressed, produces data summary printout.
PRESET pushbutton	With FUNCTION switch set to PROGRAM and a channel switch (1-5) depressed, depressing PRESET switch recalls nonvolatile factory program for that channel.

For the example cited, program the 6003 as follows:

a. Set FUNCTION switch to PROGRAM.

b. Depress the channel pushbutton (1-5) that corresponds to the slot position of the plug-in to be programmed. Note that a program summary for that channel is immediately printed.

c. Note that a cueing indicator above the center bank of pushbuttons lights. This indicates that a function may be programmed.

d. Depress the HI LIMIT pushbutton. Program the high limit value (125), using the keyboard.

e. When the ENTER indicator lights, depress the ENTER pushbutton. The programmed high limit value will be echoed back on the printout and the ENTER indicator will go out.

f. Repeat steps c, d and e for the low limit voltage (105V) using the LO LIMIT pushbutton.

g. Repeat steps c, d and e for the voltage sensitivity, using the SENS pushbutton and programming the voltage value as 02.

h. Repeat steps c, d and e for the frequency sensitivity (0.2 Hz), using the F SENS pushbutton and programming the value as 0.2.

i. Repeat steps c, d and e for the impulse sensitivity (025 volts), using the IMP SENS pushbutton. The completed program printout should take the following form:

IMPULSE SENS	0025V	
FREQ SENS	00.2 HZ	↑
VOLTAGE SENS	002 V	(Read Up)
V LOW LIMIT	105 V	
V HIGH LIMIT	125 V	
626-PA-6003		
CH 4		

NOTE

The instrument is designed to detect an invalid entry and to automatically shift high and low limits.

j. When the plug-in program is completed, the user may proceed to program another module (by depressing another channel number) or he may place the instrument on line by setting the FUNCTION switch to OPERATE. While on line, the program in effect may be obtained by simply depressing the PROG pushbutton.

8 SELECTING THE FACTORY PRESET PROGRAM

To select the program stored in hard memory, set the FUNCTION switch to PROGRAM and depress the channel number desired. The last operator-set program will be printed out. Now depress the PRESET pushbutton to recall the factory-set program. An example of this sequence appears on the following page.

	IMPULSE SENS 0100V	
	FREQ SENS 00.5 HZ	
	VOLTAGE SENS 002V	
	V LOW LIMIT 105 V	
	V HIGH LIMIT 120 V	
↑	626-PA-6001	Factory
	CH 1	Program
	PROGRAM SUMMARY	
(Read Up)		Press PRESET
	IMPULSE SENS 0025V	
|	FREQ SENS 00.2 HZ	Operator
|	VOLTAGE SENS 002 V	Program
|	V LOW LIMIT 105 V	
|	V HIGH LIMIT 125 V	
|	626-PA-6001	
|	CH 1	
|	PROGRAM SUMMARY	

9 DESCRIPTION OF DATA PRINTOUTS

When any of the disturbances described below is detected by the 6003, it is recorded and displayed in characteristic manner.

9.1 Overvoltage

An overvoltage condition exists when the monitored power line voltage exceeds the user-specified upper limit for more than 2.55 seconds. An overvoltage condition is indicated by a printout such as the following:

4B HI 09:46:07.11

where 4 is the channel number, B is the phase and time is given in hours, minutes and seconds (to .01 sec resolution).

When the line voltage recovers to normal, a printout such as the following occurs:

↑	4B NOR 09:46:15.20
|	148.6 V MAX

indicating when normal voltage was restored and the value of the highest voltage reached during the overvoltage interval.

9.2 Undervoltage

An undervoltage condition exists when the monitored power line voltage remains below the user-specified lower limit for more than 2.55 seconds. An undervoltage condition is indicated by a printout such as the following:

```
4C  LO   09:46:15.20
```

When the line voltage returns to normal level, a message such as the following is printed:

```
↑   4C  NOR   09:46:18.45
        36.4  V  MIN
```

indicating when normal voltage was restored and the value of the lowest voltage reached during the undervoltage interval.

9.3 Voltage Change

A voltage change printout is triggered when the line voltage changes more than a preselected amount from the last printed value. The voltage change sensitivity is a user-selected integral voltage between one and 15 volts for a 115-volt line. The following example shows several voltage change printouts:

	Printout	Remarks
	2C INC 01:02:34.56 115.4 V	Phase C voltage in Channel 2 increased to 115.4V at time shown
↑	3A DEC 01:02:34.56 109.2 V	Phase A voltage in Channel 3 decreased to 109.2V at time shown

9.4 Voltage Surge

A Voltage Surge is defined as a line voltage which increases through a user-selected upper limit and then returns to an in-tolerance condition in less than 2.56 seconds. When a surge begins, its starting time is printed as follows:

```
4B  HI   09:45:33.15
```

When the line voltage returns to a normal level following a Surge condition, a message such as the following will be printed:

```
4B  NOR   09:45:33.38
    128.2 V MAX
    SURGE 0.23 SEC
```

In this case, the time at which the voltage returned to normal is shown as well as the maximum voltage reached and the surge duration.

9.5 Voltage Sag

A Voltage Sag is defined as a line voltage that decreases below the user-selected lower limit and then returns to an in-tolerance condition in less than 2.56 seconds. Sag printouts take the same form as surge printouts, with the term SAG replacing the term SURGE, and the term MIN replacing the term MAX.

NOTE

Voltage inputs less than 25V RMS will be printed out as 0.0V on the 6003.

9.6 Impulses

"Impulse" disturbances represent any line perturbation which contains frequency components in the 300 Hz to 500 kHz range. An impulse type disturbance produces a printout such as the following:

```
2A  IMP  10:12:13.45
    +0139 V,  0010 US
```

This printout indicates that an impulse which deviated from normal line voltage by +139 volts peak and whose duration was 10 microseconds was detected on phase A of Channel 2 at the time shown. Impulse polarity is referenced to "+" and "-" markings on rear panel.

10 CALIBRATE

When the PRINTOUT MODE switch is set to CALIBRATE, a source of precise signals is applied to the front end circuitry of the 6003. Any inputs connected at this time will be automatically disconnected during the calibration period. Successful measurement of these calibration signals fully verify the functionality of the module. Expected calibration measurement results and allowable tolerances are listed below.

AC Voltage	196.0 - 204.0 Volts
Impulse Peak	2700 - 3300 Volts
Impulse Duration	360 - 440 µSec
Frequency	59.8 - 60.2 Hz

11 PRINTOUT MODES

The setting of the PRINTOUT MODE switch on the front panel of the mainframe determines how much detail is printed out. Printout data is reduced as the switch is rotated counterclockwise.

The following example printouts show how various settings of the PRINTOUT MODE switch change the amount of detail in the printed record of a disturbance. It is assumed that the disturbances occurred in phase A of Channel 1 and that the limits for Channel 1 were programmed as follows:

V LOW LIMIT	105 Vrms
V HIGH LIMIT	125 Vrms
V SENSITIVITY	2 Vrms

The example printouts are referenced to figures 2 and 3 which illustrate overvoltage and voltage sag disturbances, respectively.

Disturbances which occur while the PRINTOUT MODE switch is in the SUMMARY ONLY position do not generate individual printouts but they are stored in the daily accumulator and are automatically printed each day at midnight (worst case event and number of occurrences in each category). This printout may also be triggered manually be depressing the DATA button.

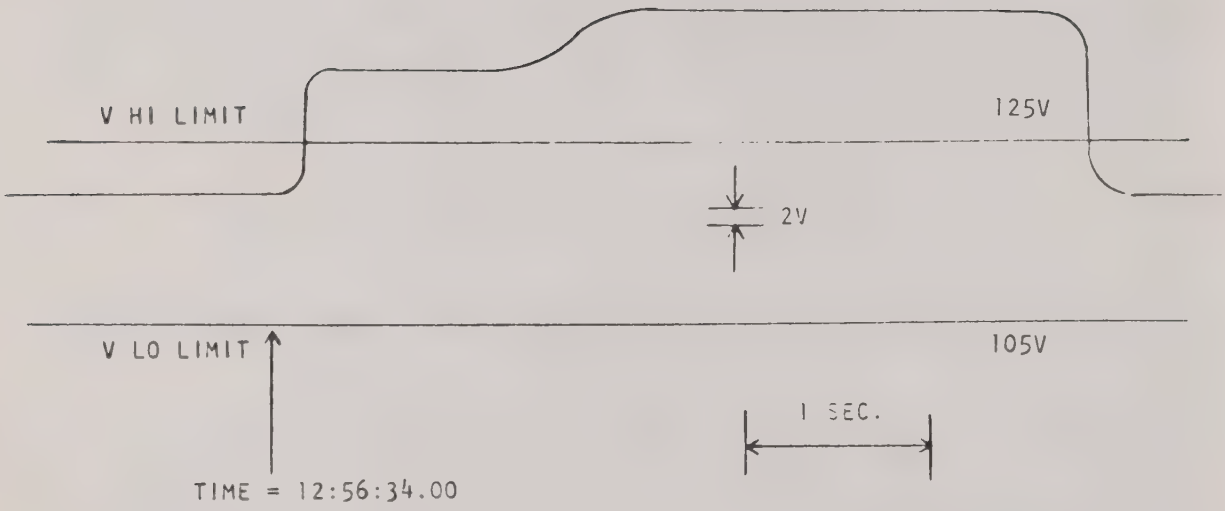


Figure 2. Overvoltage Disturbance (6003)

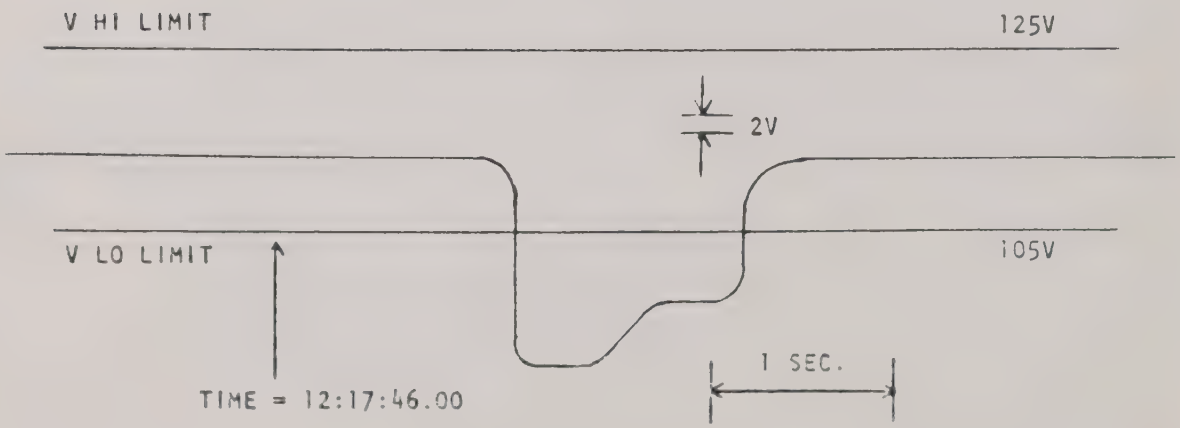


Figure 3. Voltage Sag Disturbance (6003)

1A NOR 12:56:38.51
139.1 V MAX

1A HI 12:56:34.21

Printout of overvoltage (fig. 2) in OUT-OF LIMITS ONLY mode

(Read Up)

1A NOR 12:56:38.51
139.1 V Max

1A DEC 12:56:38.50
130.2 V

1A INC 12:56:35.78
137.3 V

1A INC 12:56:35.62
135.3 V

1A INC 12:56:35.40
133.3 V

1A INC 12:56:34.22
131.3 V

1A INC 12:56:34.21
129.2 V

1A HI 12:56:34.21

Printout of overvoltage (fig. 2) in NORMAL mode

```
1A  DEC  12:56:38.61
    119.8  V

1A  DEC  12:56:38.53
    121.8  V

1A  DEC  12:56:38.51
    124.0  V

1A  NOR  12:56:38.51
    139.1  V  MAX

1A  DEC  12:56:38.50
    130.2  V

1A  INC  12:56:35.78
    137.3  V

1A  INC  12:56:35.62
    135.3  V

1A  INC  12:56:35.40
    133.3  V

1A  INC  12:56:34.22
    131.3  V

1A  INC  12:56:34.21
    129.2  V

1A  HI     12:56:34.21

1A  INC  12:56:34.20
    121.1  V

1A  INC  12:50:12.34
    119.0  V
```

(Read Up)

Printout of overvoltage (fig. 2) in MAXIMUM DETAIL mode

```
1A  NOR  12:17:48.61
    090.1  V  MIN
    SAG  1.25  SEC

1A  LO    12:17:47.36
```

Printout of voltage sag (fig. 3) in OUT-OF-LIMITS ONLY mode

(Read Up)

```
1A  NOR  12:17:48.61
    090.1  V  MIN
    SAG  1.25  SEC

1A  INC  12:17:48.60
    103.1  V

1A  INC  12:17:48.55
    098.0  V

1A  INC  12:17:48.05
    096.0  V

1A  INC  12:17:47.96
    094.0  V

1A  DEC  12:17:47.39
    091.9  V

1A  DEC  12:17:47.37
    094.1  V

1A  DEC  12:17:47.36
    101.3  V

1A  LO    12:17:47.36
```

Printout of voltage sag (fig. 3) in NORMAL mode

```
1A  INC  12:17:48.86
    112.1  V

1A  INC  12:17:48.69
    110.1  V

1A  INC  12:17:48.62
    108.1  V

1A  INC  12:17:48.61
    105.9  V

1A  NOR  12:17:48.61
    090.1  V  MIN
    SAG  1.25  SEC

1A  INC  12:17:48.60
    103.1  V

1A  INC  12:17:48.55
    098.0  V

1A  INC  12:17:48.05
    096.0  V

1A  INC  12:17:47.96
    094.0  V

1A  DEC  12:17:47.39
    091.9  V

1A  DEC  12:17:47.37
    094.1  V

1A  DEC  12:17:47.36
    101.3  V

1A  LO   12:17:47.36

1A  DEC  12:17:47.35
    110.8  V

1A  INC  12:16:32.15
    113.0  V
```

(Read Up)

Printout of voltage sag (fig. 3) in MAXIMUM DETAIL mode

12 626 Module Capacity

The 626 standard mainframe has an upper limit of the total load rating of the installed modules. The overall mainframe capacity is set at 13 units, and individual modules have load ratings as follows:

Plug-in	Load Rating
626-PA-6001	2 Units
626-PA-6001 With Extra Option Board	3 Units
626-PA-6002	2 Units
626-PA-6003	4 Units
626-PA-6006	2 Units
626-PA-6007	1 Unit
626-PA-6011	1 Unit
(626-PA-6012)	3 Units

When selecting modules for installation in any mainframe, simply verify that the sum of the load ratings of the installed modules does not exceed 13.

13 Standard Accessories

Model No.	Part No.	Quan.	Description
626PA6003-1 (Barrier Block Connections)	TM110235	1	Operating Manual
626PA6003-2 (Plug-type Connections)	TM110235	1	Operating Manual
	110480-G1	3	A.C. Cables

www.manualsplus.com
1001383

8-A-4-C

WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electrical Code (ANSI C1) and/or any other requirements which may be applicable to the user.

Installation, operation, and maintenance should be performed only by qualified personnel.

(REV. A)

TM-110235

VOLUME I

OPERATOR'S MANUAL

626-PA-6003

3-PHASE AC MONITOR

1 October 1981

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DRANETZ ENGINEERING LABORATORIES, INCORPORATED
1000 New Durham Road, CN-91, Edison, N.J. 08818

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626-PA-6003 3-PHASE AC MONITOR

1 INTRODUCTION

This manual provides instructions for the 626-PA-6003 Plug-in, hereinafter referred to as the 6003, used in the Model 626 Universal Disturbance Analyzer. It is assumed that the reader is familiar with the mainframe information described in TM-106650.

2 PURPOSE

The 6003 monitors disturbances on 3-phase AC power lines. Each phase is monitored on a single voltage range of 0 to 600V RMS. With thresholds programmed by the user, the 6003 monitors both short and long term power line disturbances. With this plug-in, the unit stores, analyzes, classifies and prints out quantative and qualitative disturbance data. Accompanying the data is a printout of time derived from a highly accurate crystal-controlled 24-hour clock in the mainframe.

The plug-in monitors any 3-phase power line whose RMS values range from a low value of 0 volts to as high as 600 volts. Three types of disturbances are monitored by the 6003: power line frequency, power frequency transients and waveform disturbances. Power frequency transients are divided into five display categories: overvoltage, undervoltage, voltage change, voltage surge and voltage sag. Waveform disturbances, identified as "impulses," include all conditions that cause the power line waveform to deviate from an ideal waveform. The 6003 measures the peak amplitude of impulses, their polarity and duration. The threshold value of each type of disturbance, as well as the line frequency, above which detection and printout occurs is operator programmable. (All threshold settings are common to all three line phases.) Except for an automatic summary printout at the end of each day, disturbance data is normally printed out only when disturbances occur. In an alternate mode, a disturbance data summary printout occurs only at the end of each day. This feature permits long term unattended operation.

The threshold program may be easily altered, using the front panel switches. Cueing indicators adjacent to the programming switches simplify the programming procedure. A back-up program for the plug-in, stored in hard memory at the factory, may always be recalled upon operator demand. Both the program and the disturbance data in the data accumulators may be printed out upon demand.

NOTE: Frequency measurements are derived from phase A only. Therefore, if single-phase monitoring is desired, phase A should be used.

3 APPLICATIONS

When installed in the 626 mainframe, the 6003 provides the capability of monitoring and evaluating power system performance. Among its typical applications are the following:

a. To determine the effect of power systems operation on equipment malfunction. The time-referenced power fault disturbance record produced by the instrument permits rapid correlation of errors, outages, and equipment damage in computer, industrial process controls, digital communications equipment, medical monitoring apparatus, and so forth, to power line faults.

b. To perform pre-installation site surveys. The 6003 can be used to determine the adequacy of existing power lines intended to support critical electrical equipment. Anticipation of power problems saves time, money, and future trouble.

c. For diagnostic evaluation of power system performance. The portable instrument, particularly well suited for field use, is ideal for determining the probable causes of, and remedies for, power line disturbances.

d. For monitoring life test racks. The printout produced by the instrument provides a clear record of the quality of power supplied during unattended periods.

4 EQUIPMENT CHARACTERISTICS

The 6003 is configured as a plug-in module 6.5" high by 1.25" wide by 10" deep. It is designed for installation in one of four slots of the Model 626 Universal Disturbance Analyzer. Technical specifications of the 6003 are presented in Table 1.

Table 1. 626-PA-6003 Technical Specifications

Input	2 wire differential Z_{in} = 40 Megohms plus 40 pf (each side to ground)
Input Voltage Range	0-600V RMS
Lower Limit of User-Set Voltage (V_{LOW})	50V to 599V
Upper Limit of User-Set Voltage (V_{HIGH})	600V to 51V
Voltage Change Sensitivity (V_{SENS}) (1V Increments)	2 to 60V
Line Voltage Measurement Resolution	0.2V

Table 1. 626-PA-6003 Technical Specifications (Cont'd.)

Line Voltage Measurement Accuracy	±1% of reading, ±0.2% of full scale (75V to 600V)
Line Frequency	
Range	45 - 65 Hz
Resolution	±0.1 Hz
Accuracy	±0.1 Hz
Impulse Range	25 -4000V Pk (1-2000 uSec)
Impulse Peak Resolution	1 V
Impulse Accuracy	±10% of reading ±1%F.S. (5μSec-50μSec.) (decreasing to ±6db from 1μSec to 2mSec) 100V-4000V
Impulse Duration Range	1 uSec to 2 mSec
Impulse Duration Resolution	1 uSec

5 INSTALLATION

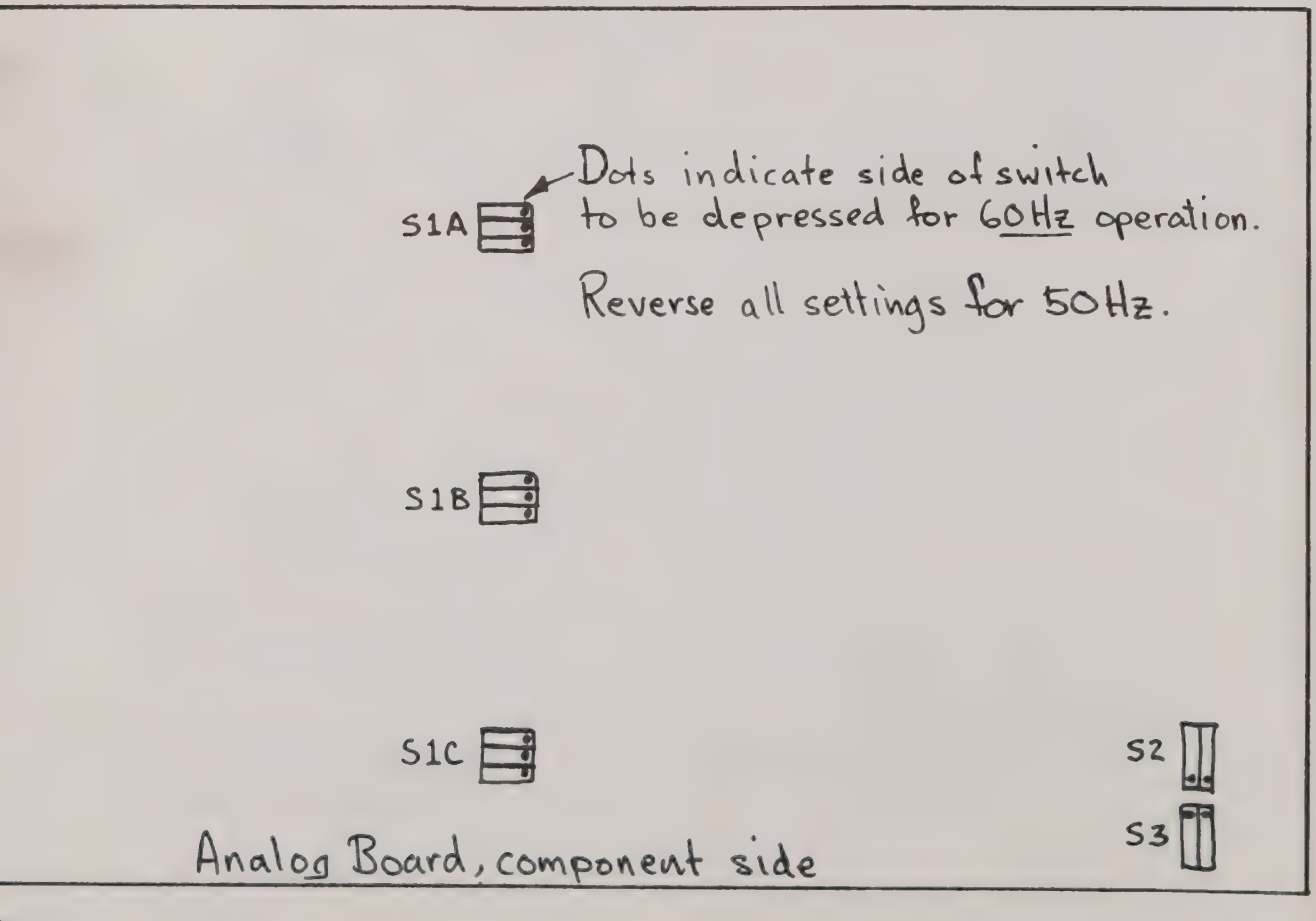
5.1 Selection of Nominal Operating Frequency

The 6003 has switches which are factory set so that measurements are optimized for a nominal frequency of either 50 or 60 Hz. Figure below shows the location of these switches on the Analog board of the module. Dots on switches on the figure indicate which side of the switch is to be depressed for 60Hz. For 50 Hz operation, simply reverse all switches.

5.2 Installation of 6003 in Mainframe

Do not attempt to install a 6003 module in slot 5 of the 626 mainframe. Slots 1-4 may be used, as follows:

a. With the rear panel markings reading correctly, carefully slide the module into the desired slot, with the Digital board within the card-guide tracks, until it is firmly seated.
b. Tighten the top and bottom captive screws to secure the module into the mainframe.



6 CONNECTING POWER SOURCE TO MODULE (See Figure 4)

The 6003 is equipped with three rear panel AC connectors, one each for phase A, B, and C. Mating connectors are supplied for the user. The 3-wire mating connectors must be wired in accordance with the rear panel connector markings (AC high, AC low, and earth ground from top to bottom).

a. Insert key in FUNCTION key switch on front panel of mainframe and set switch to OFF position.

b. Turn off AC power source that is to be used to power the module.

c. Attach the wired mating connector to the rear panel connector, then reapply AC power.

CAUTION

To avoid damaging the equipment, do not apply AC voltages in excess of 600V RMS to any AC phase (A, B, or C) applied to the 6003.

7 OPERATING THE 6003

7.1 Operating Controls and Indicators

The functions of the mainframe operating controls and indicators associated with 6003 operation are described in Table 2. Figure 1 shows the typical front panel controls on a Model 626 that are associated with a 6003 module. For a description of controls common to overall Model 626 operation, refer to TM-106650.

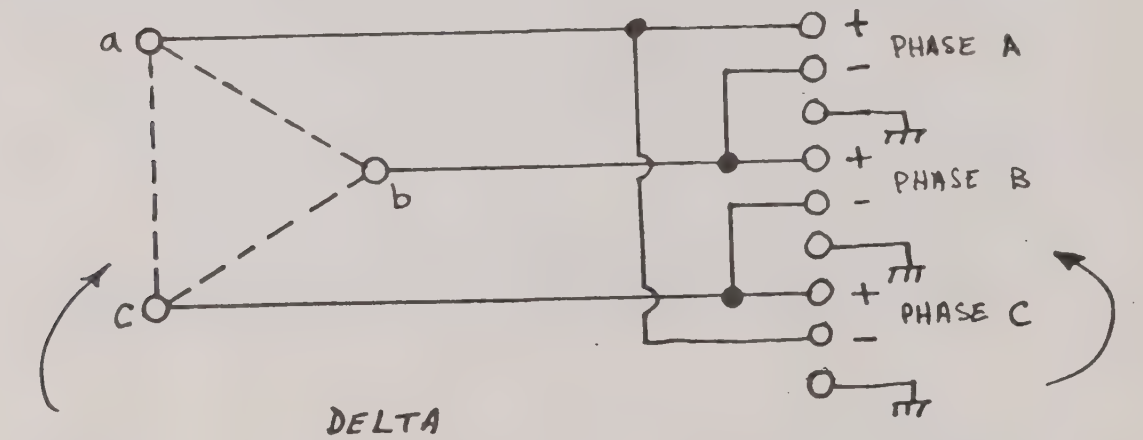
7.2 Programming Procedure

Assume it is desired to program a high limit of 125V, a low limit of 105V, voltage sensitivity of 2 volts, frequency sensitivity of 0.2 Hz and an impulse sensitivity of 25V. Sensitivity sets the deviation from the present value above or below which a detected value produces a recorded disturbance. This is true for both voltage and frequency.

For impulse measurements, the sensitivity corresponds to the absolute threshold, so that an impulse sensitivity of 25 volts, a disturbance is recorded when impulse amplitude rises above 25 volts.

626-PA-6003

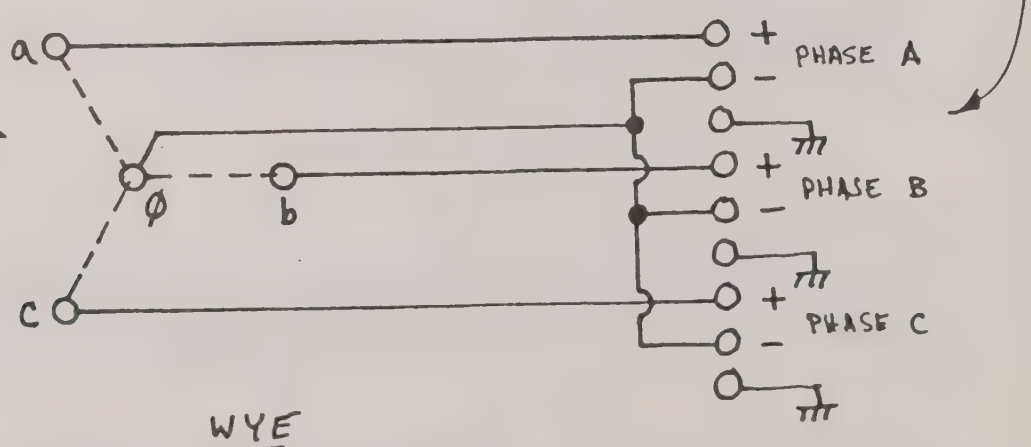
SUGGESTED THREE-PHASE CONNECTIONS



DELTA

VOLTAGE SOURCE

626-PA-6003 REAR PANEL CONNECTIONS

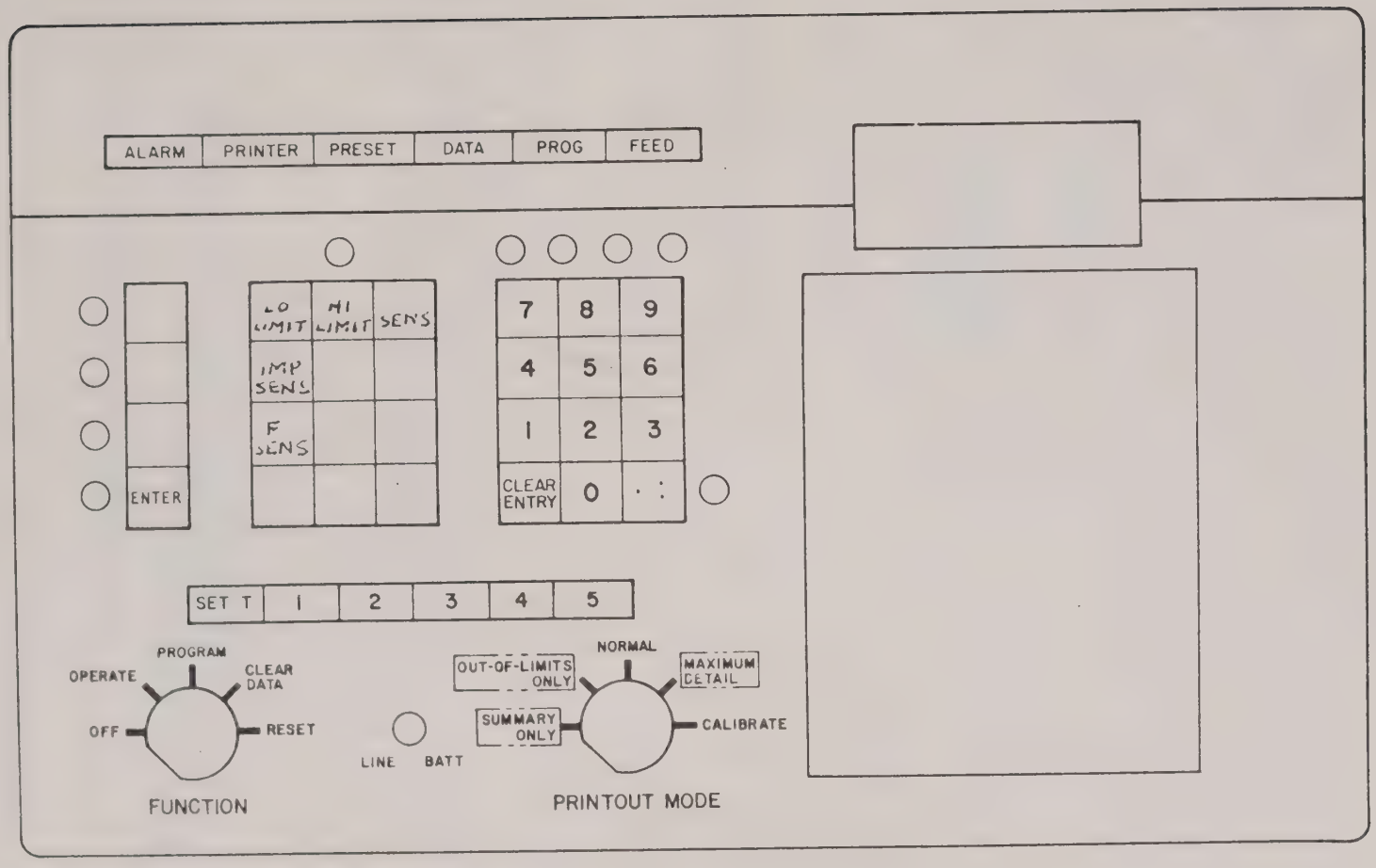


WYE

Plug-type connector color code:

BLACK to "+" on rear panel
WHITE to "–" on rear panel
GREEN to "⏚" on rear panel

Figure 4.



TM-110235

Figure 1. Typical Front Panel with 6003 Installed in Mainframe

Table 2. 6003 Operating Controls

Item	Function
LO LIMIT pushbutton	When depressed, enables numeric keyboard to program low limit voltage.
HI LIMIT pushbutton	When depressed, enables numeric keyboard to program high limit voltage.
SENS pushbutton	When depressed, enables numeric keyboard to program voltage sensitivity value.
IMP SENS pushbutton	When depressed, enables numeric keyboard to program impulse voltage sensitivity value.
F SENS pushbutton	When depressed, enables numeric keyboard to program frequency sensitivity value.
ENTER pushbutton	When depressed, transfers numeric keyboard value into the 6003 memory.
DATA pushbutton	When depressed, produces data summary printout.
PRESET pushbutton	With FUNCTION switch set to PROGRAM and a channel switch (1-5) depressed, depressing PRESET switch recalls nonvolatile factory program for that channel.

For the example cited, program the 6003 as follows:

a. Set FUNCTION switch to PROGRAM.

b. Depress the channel pushbutton (1-5) that corresponds to the slot position of the plug-in to be programmed. Note that a program summary for that channel is immediately printed.

c. Note that a cueing indicator above the center bank of pushbuttons lights. This indicates that a function may be programmed.

d. Depress the HI LIMIT pushbutton. Program the high limit value (125), using the keyboard.

e. When the ENTER indicator lights, depress the ENTER pushbutton. The programmed high limit value will be echoed back on the printout and the ENTER indicator will go out.

f. Repeat steps c, d and e for the low limit voltage (105V) using the LO LIMIT pushbutton.

g. Repeat steps c, d and e for the voltage sensitivity, using the SENS pushbutton and programming the voltage value as 02.

h. Repeat steps c, d and e for the frequency sensitivity (0.2 Hz), using the F SENS pushbutton and programming the value as 0.2.

i. Repeat steps c, d and e for the impulse sensitivity (025 volts), using the IMP SENS pushbutton. The completed program printout should take the following form:

IMPULSE SENS	0025V	
FREQ SENS	00.2 HZ	↑
VOLTAGE SENS	002 V	(Read Up)
V LOW LIMIT	105 V	
V HIGH LIMIT	125 V	

626-PA-6003
CH 4

NOTE

The instrument is designed to detect an invalid entry and to automatically shift high and low limits.

j. When the plug-in program is completed, the user may proceed to program another module (by depressing another channel number) or he may place the instrument on line by setting the FUNCTION switch to OPERATE. While on line, the program in effect may be obtained by simply depressing the PROG pushbutton.

8 SELECTING THE FACTORY PRESET PROGRAM

To select the program stored in hard memory, set the FUNCTION switch to PROGRAM and depress the channel number desired. The last operator-set program will be printed out. Now depress the PRESET pushbutton to recall the factory-set program. An example of this sequence appears on the following page.

IMPULSE SENS 0100V
FREQ SENS 00.5 HZ
VOLTAGE SENS 002V
V LOW LIMIT 105 V
V HIGH LIMIT 120 V
626-PA-6001
CH 1
PROGRAM SUMMARY

Factory Program

Press PRESET

IMPULSE SENS 0025V
FREQ SENS 00.2 HZ
VOLTAGE SENS 002 V
V LOW LIMIT 105 V
V HIGH LIMIT 125 V
626-PA-6001
CH 1
PROGRAM SUMMARY

Operator Program

9 DESCRIPTION OF DATA PRINTOUTS

When any of the disturbances described below is detected by the 6003, it is recorded and displayed in characteristic manner.

9.1 Overvoltage

An overvoltage condition exists when the monitored power line voltage exceeds the user-specified upper limit for more than 2.55 seconds. An overvoltage condition is indicated by a printout such as the following:

4B HI 09:46:07.11

where 4 is the channel number, B is the phase and time is given in hours, minutes and seconds (to .01 sec resolution).

When the line voltage recovers to normal, a printout such as the following occurs:

4B NOR 09:46:15.20
148.6 V MAX

indicating when normal voltage was restored and the value of the highest voltage reached during the overvoltage interval.

9.2 Undervoltage

An undervoltage condition exists when the monitored power line voltage remains below the user-specified lower limit for more than 2.55 seconds. An undervoltage condition is indicated by a printout such as the following:

```
4C  LO   09:46:15.20
```

When the line voltage returns to normal level, a message such as the following is printed:

```
↑   4C  NOR   09:46:18.45
        36.4  V  MIN
```

indicating when normal voltage was restored and the value of the lowest voltage reached during the undervoltage interval.

9.3 Voltage Change

A voltage change printout is triggered when the line voltage changes more than a preselected amount from the last printed value. The voltage change sensitivity is a user-selected integral voltage between one and 15 volts for a 115-volt line. The following example shows several voltage change printouts:

	Printout	Remarks
2C	INC 01:02:34.56 115.4 V	Phase C voltage in Channel 2 increased to 115.4V at time shown
3A	DEC 01:02:34.56 109.2 V	Phase A voltage in Channel 3 decreased to 109.2V at time shown

9.4 Voltage Surge

A Voltage Surge is defined as a line voltage which increases through a user-selected upper limit and then returns to an in-tolerance condition in less than 2.56 seconds. When a surge begins, its starting time is printed as follows:

```
4B  HI   09:45:33.15
```

When the line voltage returns to a normal level following a Surge condition, a message such as the following will be printed:

```
4B  NOR   09:45:33.38
    128.2 V MAX
    SURGE 0.23 SEC
```

In this case, the time at which the voltage returned to normal is shown as well as the maximum voltage reached and the surge duration.

9.5 Voltage Sag

A Voltage Sag is defined as a line voltage that decreases below the user-selected lower limit and then returns to an in-tolerance condition in less than 2.56 seconds. Sag printouts take the same form as surge printouts, with the term SAG replacing the term SURGE, and the term MIN replacing the term MAX.

NOTE

Voltage inputs less than 25V RMS will be printed out as 0.0V on the 6003.

9.6 Impulses

"Impulse" disturbances represent any line perturbation which contains frequency components in the 300 Hz to 500 kHz range. An impulse type disturbance produces a printout such as the following:

```
2A  IMP  10:12:13.45
    +0139 V,  0010 US
```

This printout indicates that an impulse which deviated from normal line voltage by +139 volts peak and whose duration was 10 microseconds was detected on phase A of Channel 2 at the time shown. Impulse polarity is referenced to "+" and "-" markings on rear panel.

10 CALIBRATE

When the PRINTOUT MODE switch is set to CALIBRATE, a source of precise signals is applied to the front end circuitry of the 6003. Any inputs connected at this time will be automatically disconnected during the calibration period. Successful measurement of these calibration signals fully verify the functionality of the module. Expected calibration measurement results and allowable tolerances are listed below.

AC Voltage	196.0 - 204.0 Volts
Impulse Peak	2700 - 3300 Volts
Impulse Duration	360 - 440 µSec
Frequency	59.8 - 60.2 Hz

11 PRINTOUT MODES

The setting of the PRINTOUT MODE switch on the front panel of the mainframe determines how much detail is printed out. Printout data is reduced as the switch is rotated counterclockwise.

The following example printouts show how various settings of the PRINTOUT MODE switch change the amount of detail in the printed record of a disturbance. It is assumed that the disturbances occurred in phase A of Channel 1 and that the limits for Channel 1 were programmed as follows:

V LOW LIMIT	105 Vrms
V HIGH LIMIT	125 Vrms
V SENSITIVITY	2 Vrms

The example printouts are referenced to figures 2 and 3 which illustrate overvoltage and voltage sag disturbances, respectively.

Disturbances which occur while the PRINTOUT MODE switch is in the SUMMARY ONLY position do not generate individual printouts but they are stored in the daily accumulator and are automatically printed each day at midnight (worst case event and number of occurrences in each category). This printout may also be triggered manually be depressing the DATA button.

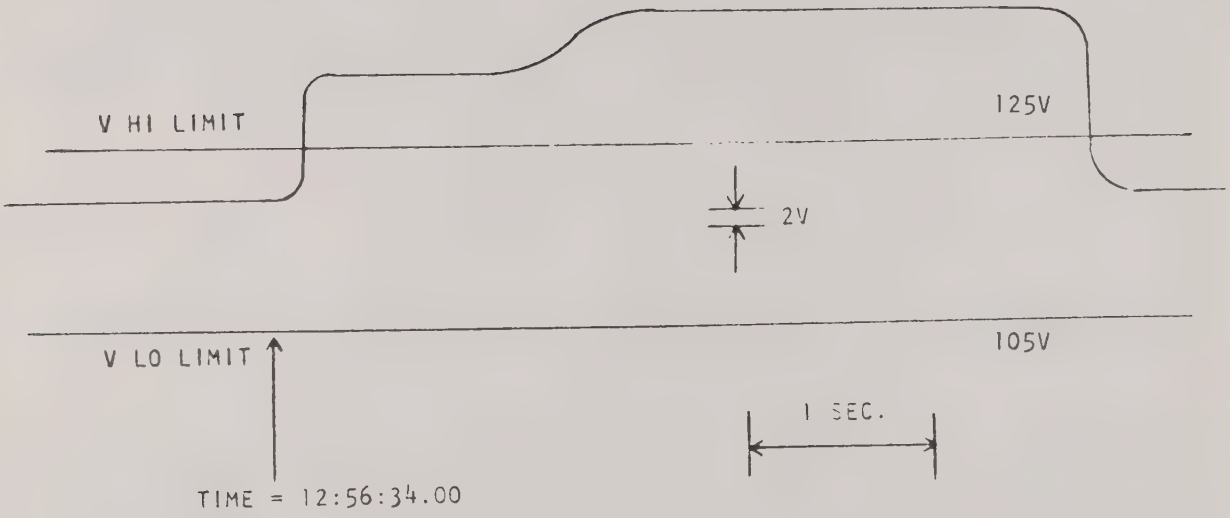


Figure 2. Overvoltage Disturbance (6003)

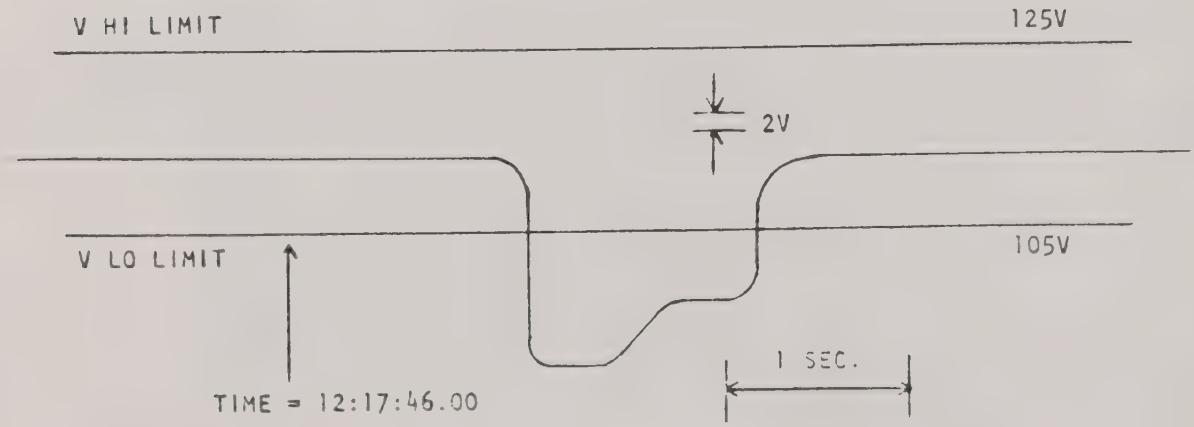


Figure 3. Voltage Sag Disturbance (6003)

1A NOR 12:56:38.51
139.1 V MAX

1A HI 12:56:34.21

Printout of overvoltage (fig. 2) in OUT-OF LIMITS ONLY mode

(Read Up)

1A NOR 12:56:38.51
139.1 V Max

1A DEC 12:56:38.50
130.2 V

1A INC 12:56:35.78
137.3 V

1A INC 12:56:35.62
135.3 V

1A INC 12:56:35.40
133.3 V

1A INC 12:56:34.22
131.3 V

1A INC 12:56:34.21
129.2 V

1A HI 12:56:34.21

Printout of overvoltage (fig. 2) in NORMAL mode

```
1A  DEC  12:56:38.61
    119.8 V

1A  DEC  12:56:38.53
    121.8 V

1A  DEC  12:56:38.51
    124.0 V

1A  NOR  12:56:38.51
    139.1 V MAX

1A  DEC  12:56:38.50
    130.2 V

1A  INC  12:56:35.78
    137.3 V

1A  INC  12:56:35.62
    135.3 V

1A  INC  12:56:35.40
    133.3 V

1A  INC  12:56:34.22
    131.3 V

1A  INC  12:56:34.21
    129.2 V

1A  HI     12:56:34.21

1A  INC  12:56:34.20
    121.1 V

1A  INC  12:50:12.34
    119.0 V
```

(Read Up)

Printout of overvoltage (fig. 2) in MAXIMUM DETAIL mode

```
1A  NOR  12:17:48.61
    090.1 V MIN
    SAG 1.25 SEC

1A  LO   12:17:47.36
```

Printout of voltage sag (fig. 3) in OUT-OF-LIMITS ONLY mode

(Read Up)

```
1A  NOR  12:17:48.61
    090.1 V MIN
    SAG 1.25 SEC

1A  INC  12:17:48.60
    103.1 V

1A  INC  12:17:48.55
    098.0 V

1A  INC  12:17:48.05
    096.0 V

1A  INC  12:17:47.96
    094.0 V

1A  DEC  12:17:47.39
    091.9 V

1A  DEC  12:17:47.37
    094.1 V

1A  DEC  12:17:47.36
    101.3 V

1A  LO   12:17:47.36
```

Printout of voltage sag (fig. 3) in NORMAL mode

```
1A  INC  12:17:48.86
    112.1  V

1A  INC  12:17:48.69
    110.1  V

1A  INC  12:17:48.62
    108.1  V

1A  INC  12:17:48.61
    105.9  V

1A  NOR  12:17:48.61
    090.1  V  MIN
    SAG  1.25  SEC

1A  INC  12:17:48.60
    103.1  V

1A  INC  12:17:48.55
    098.0  V

1A  INC  12:17:48.05
    096.0  V

1A  INC  12:17:47.96
    094.0  V

1A  DEC  12:17:47.39
    091.9  V

1A  DEC  12:17:47.37
    094.1  V

1A  DEC  12:17:47.36
    101.3  V

1A  LO   12:17:47.36

1A  DEC  12:17:47.35
    110.8  V

1A  INC  12:16:32.15
    113.0  V
```

(Read Up)

Printout of voltage sag (fig. 3) in MAXIMUM DETAIL mode

12 626 Module Capacity

The 626 standard mainframe has an upper limit of the total load rating of the installed modules. The overall mainframe capacity is set at 13 units, and individual modules have load ratings as follows:

Plug-in	Load Rating
626-PA-6001	2 Units
626-PA-6001 With Extra Option Board	3 Units
626-PA-6002	2 Units
626-PA-6003	4 Units
626-PA-6006	2 Units
626-PA-6007	1 Unit
626-PA-6011	1 Unit
(626-PA-6012)	3 Units

When selecting modules for installation in any mainframe, simply verify that the sum of the load ratings of the installed modules does not exceed 13.

13 Standard Accessories

Model No.	Part No.	Quan.	Description
626PA6003-1 (Barrier Block Connections)	TM110235	1	Operating Manual
626PA6003-2 (Plug-type Connections)	TM110235	1	Operating Manual
	110480-G1	3	A.C. Cables

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